RECOVERY PLAN FOR GRIZZLY BEARS IN THE NORTH CASCADES OF BRITISH COLUMBIA

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Consensus Recommendation Draft for Consultation

North Cascades Grizzly Bear Recovery Team

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EXECUTIVE SUMMARY

The North Cascades area contains one of the most imperiled grizzly bear populations in British Columbia with an estimate of fewer than 25 animals remaining in an area of 9 807 km^2. This population has been designated as "Threatened" under the provincial Grizzly Bear Conservation Strategy and is shared with Washington State where it is listed as "Threatened" under the United States' federal *Endangered Species Act*.

The primary factors that are believed to have caused the decline of the North Cascades grizzly bear population date back to the mid-19th century when there were high numbers of grizzly bears commercially trapped and destroyed through persecution and fear over potential conflicts. In the approximately 150 years since this population "bottleneck" the remnant population has not recovered.

The recovery planning process has been initiated under the Grizzly Bear Conservation Strategy to ensure that Threatened populations are not lost. Recovery plans are not land use plans, any existing or future approved strategic land use plans take precedence over recovery plans. Recovery plans are intended to be revised every five years based on any additional information available.

The goal of this Recovery Plan is to remove the North Cascades Grizzly Bear Population Unit from Threatened status by 2050. This represents a recovered population of approximately 150 grizzly bears.

The Recovery Plan includes the following objectives that support the goal:

1. Provide habitat of sufficient quantity and quality to support the Recovery Plan goal.
2. Prevent population fragmentation and maintain genetic diversity.
3. Increase the number of grizzly bears to achieve the Recovery Plan goal.
4. Minimize the potential for grizzly bear/human conflict.
5. Minimize human-caused mortality of grizzly bears.
6. Increase public knowledge of, and support for, grizzly bear recovery in the North Cascades.
7. Facilitate interagency cooperation and management of the North Cascades grizzly bear population.

The foundation of the Recovery Plan is providing effective grizzly bear habitat. The habitat strategies in the Recovery Plan apply only to the designated "spine" area the majority of important habitats in the North Cascades. The only exception is if new information documents areas where resident grizzly bear(s) are present outside the "spine". The major focus under objective #1 is on avoiding net impacts to grizzly bears over time from the development of new access routes and providing security for grizzly bears to utilize a suite of important habitats that will provide for their seasonal needs.

The North Cascades grizzly bear population is potentially isolated from other grizzly bear populations by both topographic features and human developments and activities. The closest grizzly bear population to the North Cascades is the Stein-Nahatlatch, which is west of the Fraser River. There are also internal sources of fragmentation resulting from major highways and other human developments. The strategies under objective #2 involve identifying any potentially viable

linkage areas both within the North Cascades Grizzly Bear Population Unit and between the North Cascades and Stein-Nahatlatch populations, implementing measures to conserve and enhance those linkages and augmenting the population genetically through the introduction of animals from other populations (see objective #3).

Given that the North Cascades population has not recovered over the last 150 years it is considered highly unlikely that the population will do so in the absence of active recovery efforts. The strategies under objective #3 deal with the augmentation of the population with grizzly bears from other, healthy, populations. Augmentation will take place in the Manning West and East sub-units and will not occur until the recovery team is satisfied that appropriate measures have been implemented to minimize the potential for grizzly bear/human conflicts.

Avoiding grizzly bear/human conflicts will be critical to the success of the Recovery Plan. The strategies under objective #4 emphasize preventing conflicts through education, planning and infrastructure improvements as well as responding effectively to any conflicts that do occur.

Given the small size of the North Cascades grizzly bear population, the loss of animals is extremely detrimental to the long-term prospects for recovery. As a result, limiting human-caused mortality of grizzly bears through education, planning and enforcement is the focus of the strategies under objective #5.

The strategies included under objective #6 seek to improve the currently limited knowledge of grizzly bears in the North Cascades through outreach programs and by encouraging research. Public support for recovery efforts will be encouraged through an information and education program and fundraising will be undertaken to provide financial assistance with the implementation of the Recovery Plan.

Since the North Cascades is a cross-border population it is vital that recovery efforts in British Columbia be closely coordinated with the work being undertaken in Washington State. It is equally important that the various agencies responsible for the management of grizzly bears and their habitats in British Columbia continue to work together to achieve recovery. The strategies under objective #7 are intended to ensure that this interagency cooperation is maintained and enhanced.

Finally monitoring must be conducted on an on-going basis to assess the success of the various strategies in the Recovery Plan in contributing toward the achievement of the plan's goal. This monitoring will include indicator(s) of population size and distribution, habitat conditions (including human impacts), grizzly bear mortalities and the number and nature of any conflicts.

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ACRONYMS USED IN THIS DOCUMENT

CWD	Coarse Woody Debris
FES	Forest Ecosystem Specialist
FPC	*Forest Practices Code of British Columbia Act*
GBCS	Grizzly Bear Conservation Strategy
GBPU	Grizzly Bear Population Unit
IGBC	Interagency Grizzly Bear Committee
IWMS	Identified Wildlife Management Strategy
MELP	Ministry of Environment, Lands and Parks
MEM	Ministry of Energy and Mines
MOF	Ministry of Forests
OGMA	Old Growth Management Area
ORD	Open Road Density
WHA	Wildlife Habitat Area
WTP	Wildlife Tree Patch

1 INTRODUCTION

1.1 Background on Grizzly Bears

Grizzly bears (*Ursus arctos horribilis*) are omnivores that require large tracts of suitable habitat to meet their ecological requirements (Appendix 1). Although grizzly bears can live over 30 years, females do not reach sexual maturity until age 5 or 6 and have small litters of 1-4 cubs every 3-4 years. As a result of this low rate of reproduction grizzly bear populations are vulnerable to excessive human-caused mortality and even under ideal conditions only have the potential to grow relatively slowly compared to other species.

Due to persecution by humans as well habitat impacts including human settlement, hydroelectric development, road building, resource extraction and agriculture the range of grizzly bears has been significantly reduced in North America (Figure 1). A number of the populations along the southern portion of the current range of grizzly bears are considered to be at risk of extirpation.

1.2 Grizzly Bears in British Columbia

British Columbia is home to an estimated minimum of 13 000 grizzly bears, approximately half the Canadian population and one quarter of the grizzly bears remaining in North America. The current provincial population is only half of estimated historic numbers in the province and grizzly bears have been extirpated from approximately 10% of their former range in British Columbia. This decline in numbers and range can be attributed to unsustainable levels of human-caused mortality and the loss of effective habitat. As a result of their vulnerability to human impacts, grizzly bears are Blue-listed in British Columbia and are listed as Vulnerable nationally in Canada.

In 1995 British Columbia launched the Grizzly Bear Conservation Strategy (GBCS), a major initiative whose mandate is to ensure the continued existence of grizzly bears and their habitats for future generations. The GBCS has four goals:

- To maintain in perpetuity the diversity and abundance of grizzly bears and the ecosystems on which they depend throughout British Columbia for future generations.
- To improve the management of grizzly bears and their interactions with humans.
- To increase public knowledge and involvement in grizzly bear management.
- To increase international cooperation in management and research of grizzly bears.

The current range of grizzly bears in British Columbia has been divided into Grizzly Bear Population Units (GBPUs) which delineate individual grizzly bear populations. GBPU boundaries are features that largely restrict grizzly bear movement. Several southern population units including the North Cascades extend across the border between the U.S. and Canada.

Each GBPU in the province has been assigned a Conservation Status of either Threatened or Viable (Figure 2). This Conservation Status is linked to the Viability Class for the GBPU, which is based on the difference between the current population estimate and the estimated minimum habitat capability for the GBPU (Table 1). Habitat capability represents the ability of the habitat,

under optimal conditions to provide the life requisites of a species, irrespective of its current conditions.

Figure 1. Current and Historic Grizzly Bear Distribution in North America.

GBPUs that fall into Viability Class C or D are considered Threatened. A comprehensive Recovery Plan is to be developed to provide direction on the restoration of each Threatened GBPU to long-term viability in keeping with the mandate of the GBCS.

The selection of 50% of minimum habitat capability as the threshold below which populations are considered "threatened" is somewhat arbitrary. This is necessary because there is considerable uncertainty over what actually constitutes a "viable" grizzly bear population. In some cases a grizzly bear population may be "viable" at less than 50% of habitat capability while in other cases populations that exceed 50% may not be viable over the long-term.

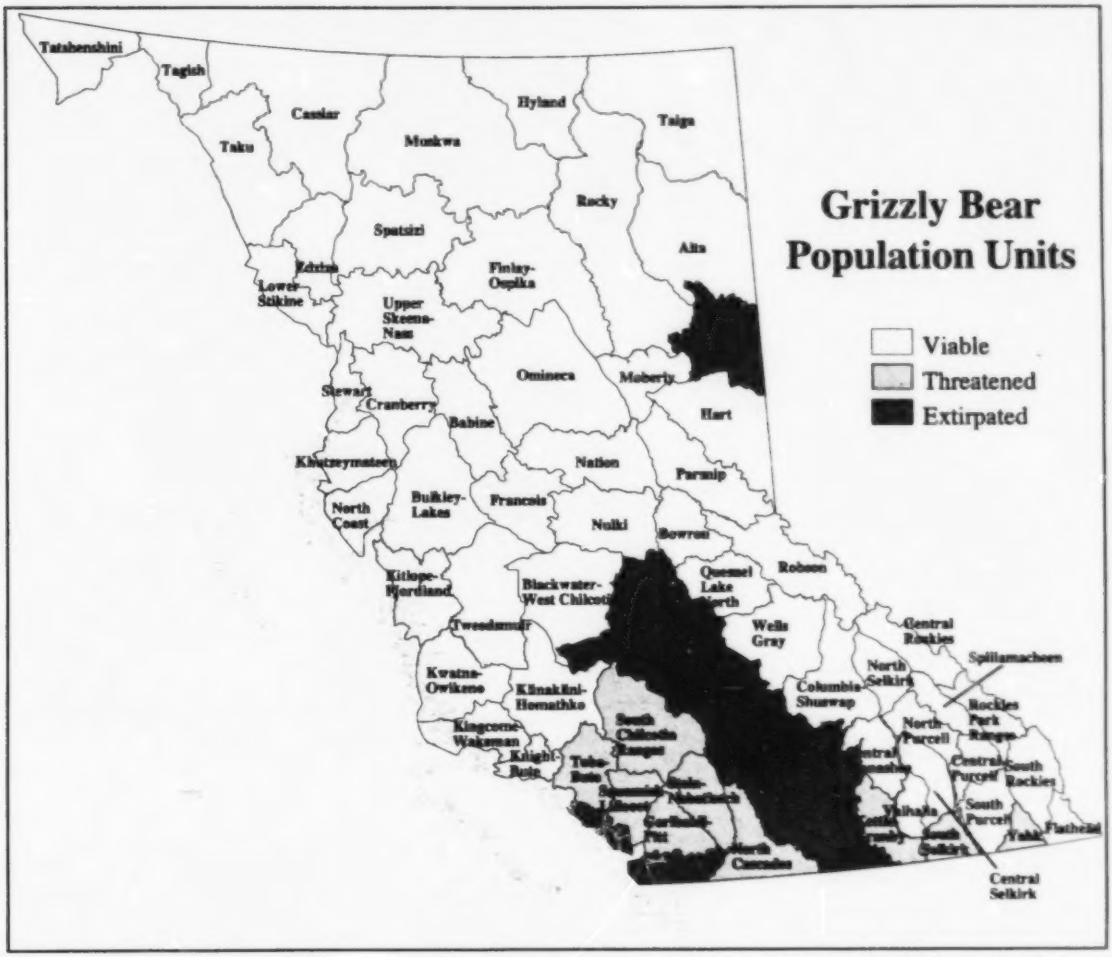

Figure 2. The Conservation Status of Grizzly Bear Population Units in British Columbia.

Table 1. The Relationship between Viability Class, Population Estimate and Conservation Status for Grizzly Bear Population Units.

Viability Class	Population Estimate	Conservation Status
A (Excellent)	75-100% of minimum habitat capability	Viable
B (Good)	50-<75% of minimum habitat capability	Viable
C (Fair)	25-<50% of minimum habitat capability	Threatened
D (Poor)	1-<25% of minimum habitat capability	Threatened
X (Extirpated)	0% of minimum habitat capability	Extirpated

1.3 The Recovery Planning Process

Recovery planning is a tool that is used to stop, and where possible reverse, the decline in a species' or population's status. Several policies direct recovery planning for grizzly bears in British Columbia:

- The GBCS states that it "will not impose new land use processes or demands on the land base over and above those already sanctioned by government."
- The Identified Wildlife Management Strategy (IWMS) under the Forest Practices Code (FPC) includes Higher Level Plan Recommendations for addressing the needs of this sensitive species through strategic land use plans such as Land Resource Management Plans. The IWMS states that: "...government will develop a series of options for the management of grizzly bear habitat for the planning table's consideration. These options will not include a scenario that results in a population becoming or remaining threatened throughout the population unit."
- The IWMS also states that: "Where populations are threatened with extirpation, a Recovery Plan and its Terms of Reference may be developed and approved by the Forest Practices Code ministries (Ministry of Environment, Lands & Parks, Ministry of Forests and Ministry of Energy & Mines) in consultation with local stakeholders. Recovery Plans are not land use plans but rather will use a variety of techniques to enhance threatened populations within the existing agreed upon land and resource allocations. These techniques may include the temporary prohibition of (grizzly bear) hunting where it is currently practiced, public education, reduction of bear/human conflicts and other measures."

The recovery planning process seeks "to achieve recovery within the constraints of existing government policy direction on land use and acceptable impacts on recreation and the extraction of resources (including both operational costs and timber supply)." If a technical assessment conducted by a Recovery Team indicates that this is not possible, they will request further direction within government before proceeding. The direction received will then be incorporated into the draft Recovery Plan. Recovery plans will be revised every five years based on any additional information available.

Local First Nations and stakeholders will be consulted and will have an opportunity to provide input on draft recovery plans for Threatened GBPUs before they are approved and implemented. Any existing or future approved strategic land use plans take precedence over recovery plans.

2 GRIZZLY BEARS IN THE NORTH CASCADES

The grizzly bear population in the North Cascades GBPU is quite small (i.e. <25 individuals) and is threatened by human activities. This population is shared with the State of Washington, where grizzly bears are listed as Threatened under the federal *Endangered Species Act* and are designated as "Endangered" by state legislation. As a result, recovery of grizzly bears in the North Cascades will require cooperation between the United States and Canada. The joint U.S./British Columbia commitment to recover grizzly bears in the North Cascades is stated through a Memorandum of Understanding with the Interagency Grizzly Bear Committee (IGBC) signed on behalf of the Deputy Ministers responsible for Environment, Parks and Forests.

2.1 Description of the North Cascades Grizzly Bear Population Unit

The North Cascades GBPU extends from the Canada/U.S. border north to the Thompson and Nicola River watersheds and has an area of 9 807 km^2 (Figure 3).

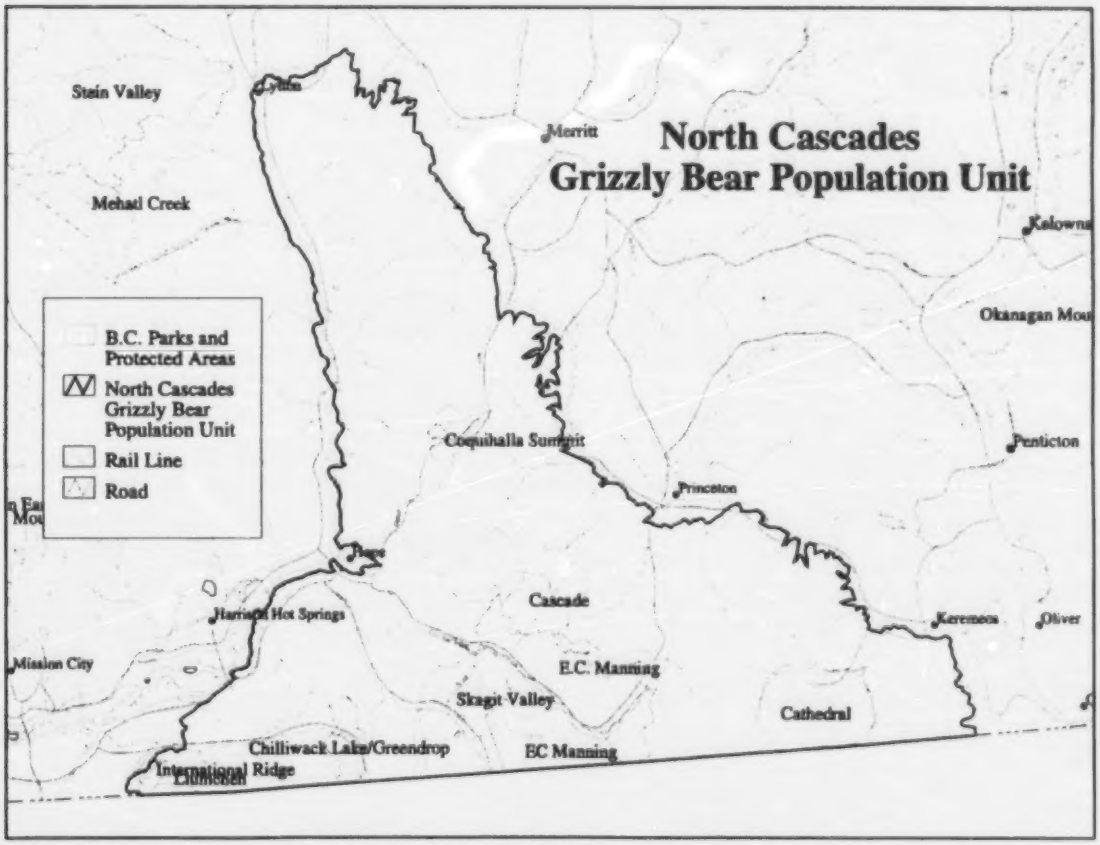

Figure 3. The North Cascades Grizzly Bear Population Unit.

The western boundary of the North Cascades GBPU is defined by the Fraser River except in the lower Fraser Valley where it extends approximately to Chilliwack. The eastern boundary is approximately from the confluence of the Nicomen and Thompson rivers to Mimenuh Mountain, from Mimenuh Mountain to Kingsvale and the Kettle Valley Railway bed between Kingsvale and Princeton and finally the Similkameen River to the Canada/U.S. border. The area includes 11 Provincial Parks, 4 Recreation Areas and 9 Ecological Reserves totaling 1 658 km^2 (16.9% of the GBPU by land area).

Biogeoclimatic Ecosystem Classification (BEC) Units found in the North Cascades GBPU are: Alpine Tundra, Coastal Western Hemlock, Engelmann Spruce-Subalpine Fir, Interior Douglas-fir, Mountain Hemlock and Montane Spruce with a very minor inclusion of the Ponderosa Pine zone near Lytton. The majority of the recovery area is forested with only limited alpine and subalpine habitats.

For the purposes of this Recovery Plan the North Cascades GBPU has been subdivided into sub-units (Figure 4) which correspond to the portions of Landscape Units designated under the *Forest Practices Code of British Columbia Act* that occur within the GBPU.

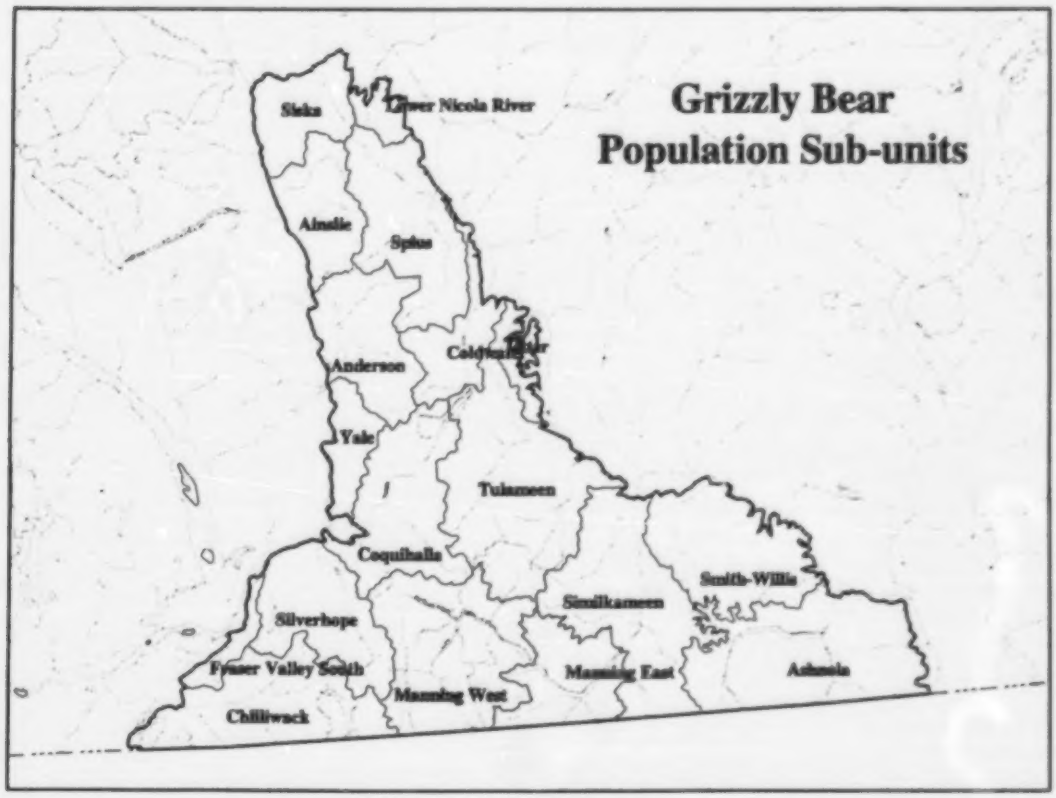

Figure 4. Sub-units within the North Cascades Grizzly Bear Population Unit.

2.2 Historic and Current Status of Grizzly Bears in the North Cascades Grizzly Bear Population Unit

Habitat capability based on Biogeoclimatic Ecosystem Classification mapping of the North Cascades GBPU indicates that under ideal conditions a population of at least 293 grizzly bears could be supported.

It is difficult to establish historical grizzly bear population numbers for the North Cascades (i.e. prior to 1960) based on data contained within available records, although based on interviews with long-time residents, the population was small as far back as the 1930s (Gyug 1998). Sullivan (1983) documented 425 grizzly hides taken from the Cascades area in the five year period from 1846 to 1851. Almack et al. (1993) concluded that this massive trapping mortality rapidly reduced the North Cascades grizzly bear population based on this evidence. There is little doubt that the present grizzly bear population of the North Cascades GBPU was once much larger.

In 1997-1998, Gyug conducted a thorough status assessment of grizzly bears in the North Cascades GBPU (Gyug 1998). A total of 124 grizzly bear records between 1962 and 1997 were assessed to estimate population size and distribution. Based on the data collected, Gyug (1998) estimated that there were at least 17 adult/subadult grizzly bears present in the North Cascades GBPU with a likely estimate of 23. Records further suggest that there are likely to be only 5-6 reproductive females in the entire North Cascades GBPU.

In 1998, the Ministry of Environment, Lands and Parks conducted a DNA inventory of grizzly bears in the North Cascades GBPU. The result of the inventory was that only one female grizzly bear was detected based on DNA analysis of a hair sample. Grizzly bears were also observed three times (one of those was a sow with a cub, the other two were individual bears).

Grizzly bears in the North Cascades appear to be relatively isolated from other grizzly bear populations. There are no known populations of grizzly bears immediately to the east, although there have been occasional records between the eastern boundary of the North Cascades GBPU and Okanagan Lake. To the west, there is a contiguous grizzly bear population from Spuzzum Creek northwards in the Stein-Nahatlatch GBPU (which is also Threatened), however, the Fraser River and associated human development and activity appears to form a substantial barrier to natural movements of grizzly bears between these areas. Grizzly bears have been extirpated from areas to the west, east and south of the U.S. portion of the North Cascades.

2.3 Human Development and Activity within the North Cascades Grizzly Bear Population Unit

Land uses within the North Cascades GBPU of significance to grizzly bears include forestry, mining, agriculture, settlement and residential development, transportation corridors, recreation, hunting and First Nations traditional use. These activities are described in detail in Appendix 2.

Important resource values of significance to management of the grizzly bear population and its recovery include the following:

- **Transportation:** There are currently three major transportation corridors associated with the North Cascades GBPU: the Fraser Canyon which forms the western boundary, occupied by the Trans-Canada Highway (Highway #1) and the Canadian Pacific and Canadian National railways; the Coquihalla toll freeway (Highway #5); and the Hope-Princeton Highway (#3) (Figure 3). Major highways and railways can represent barriers to grizzly bear movements as well as a mortality risk (i.e. from bears being struck by vehicles).
- **Forestry:** Forest harvesting has occurred within the North Cascades for over 100 years and forms an important basis for the economic health of communities in the area. Coordinating forestry activities to avoid reductions in habitat suitability and effectiveness through timber harvesting, silviculture and road construction and use is critical to grizzly recovery.
- **Mining and Mineral Exploration**: Mineral exploration and mining have formed an important part of the regional economy for over 150 years. With established mineral reserves in 8 of the 18 sub-units, and nearly 400 known mineral deposits and occurrences, sustainable access to develop the mineral resource will require integration with grizzly bear recovery.
- **Energy:** The North Cascades GBPU contains energy resources in the form of coal, coalbed gas, and small-scale hydroelectric which may see future development. Several electrical transmission corridors and natural gas pipeline routes traverse the area as well.
- **Agriculture:** Ranching and other forms of agriculture are prevalent in the eastern half of the North Cascades GBPU. Grizzly bear recovery will require coordinating livestock activities to avoid impacts on habitat as well as grizzly bear/human conflicts.
- **Settlement and Residential Development:** Current human populations within the North Cascades GBPU are small and dispersed, however, the potential for population growth exists. Management of grizzly bear/human conflict associated with both urban centres and dispersed rural settlement will be an important component of grizzly bear recovery.
- **Recreation:** Due to the fact that it is close to large urban centres in the Lower Mainland and Okanagan Valley, the North Cascades GBPU attracts significant use to parks developed for recreation. Proactive management is necessary to minimize conflicts between recreationists and grizzly bears.
- **Hunting:** There is no grizzly bear hunting season in the North Cascades, however, hunting seasons exist for a wide variety of other species including black bears. Recovery efforts will need to include measures to prevent conflicts between grizzly bears and hunters as well as the accidental killing of grizzly bears by black bear hunters.
- **First Nations:** There is long established traditional use by many First Nations bands within the North Cascades GBPU and it is important to integrate grizzly bear recovery with these uses as well as with treaty negotiations where applicable.

2.4 Recovery Planning in the North Cascades

This Recovery Plan was prepared by the North Cascades Grizzly Bear Recovery Team (NCGBRT). The Team was formally established in April 1999 and includes representatives from the Ministry of Forests, Ministry of Environment, Lands & Parks, Ministry of Energy & Mines and U.S. members from the North Cascades Subcommittee of the Interagency Grizzly Bear Committee (IGBC). The team will be expanded in 2001 to include representatives from local First Nations.

3 RECOVERY PLAN GOAL

The goal of this Recovery Plan is to remove the North Cascades Grizzly Bear Population Unit from Threatened status by the year 2050.

Achieving Viable population status for the North Cascades GBPU will require a population >50% of the GBPU's estimated minimum habitat capability. The estimated minimum habitat capability for the North Cascades GBPU is 293 grizzly bears (Appendix 5) and as a result achieving the Recovery Plan goal would represent a population of approximately 150 grizzly bears. A population of 150 grizzly bears in an area of 9 807 km^2 would correspond to a density of approximately 1.5 grizzly bears/100 km^2 – a relatively low density compared to other grizzly bear populations in North America (MacHutchon et al. 1993, McLellan 1994, Miller et al. 1997). The date for achieving the population goal is based on the assumption that augmentation will occur, that by 2005 there will be a minimum of 30 grizzly bears in the North Cascades GBPU and that the population will grow at a rate of approximately 4% per year (Figure 7).

4 OBJECTIVES AND STRATEGIES

To achieve this goal, the objectives are to:

1. Provide habitat of sufficient quantity and quality to support the Recovery Plan goal.
2. Prevent population fragmentation and maintain genetic diversity.
3. Increase the number of grizzly bears to achieve the Recovery Plan goal.
4. Minimize the potential for grizzly bear/human conflict.
5. Minimize human-caused mortality of grizzly bears.
6. Increase public knowledge of, and support for, grizzly bear recovery in the North Cascades.
7. Facilitate interagency cooperation and management of the North Cascades grizzly bear population.

4.1 Objective 1. Provide habitat of sufficient quantity and quality to support the Recovery Plan goal

The recovery of grizzly bears in the North Cascades GBPU will not be possible unless there is enough effective habitat to support these animals. The first step in examining the potential for an area to support grizzly bears is to determine its habitat capability. Habitat capability represents the ability of the habitat, under optimal conditions to provide the life requisites of a species, irrespective of its current conditions. For example, a forested area that is would support high densities of berry producing shrubs used by grizzly bears when it is at an early seral stage of succession (young forest) would have high habitat capability (even when the area was at another seral stage that provided much less food for grizzly bears).

The second step in assessing the ability of an area to support grizzly bears is to determine its habitat suitability. This reflects the actual as opposed to ideal habitat conditions based on the impacts of habitat loss and alteration. Using the example cited above of a forested area that has high habitat capability because of the value of the site to grizzly bears when it supports young forest, the same area may have lower habitat suitability when the forest is at an intermediate seral

stage where little light reaches the forest floor and therefore the berry producing shrubs are much less productive. While habitat suitability changes over time based on the actual conditions of the habitat, habitat capability remains constant. Habitat suitability can equal but never exceed habitat capability for a given area as capability represents the ideal set of conditions.

The final step in the assessment process is to determine habitat effectiveness which takes the habitat suitability of the area and further accounts for impacts such as habitat displacement and fragmentation that reduce the ability or willingness of grizzly bears to use the habitat. Continuing with the same forested habitat example, the habitat effectiveness of this site (even when suitability is high) would be low if grizzly bears were displaced from the area by the disturbance associated with roads with high traffic volume located nearby. Habitat effectiveness can equal habitat suitability but never exceed habitat suitability for a given area as suitability represents the current conditions in the absence of human disturbance and fragmentation.

Habitat capability, suitability and effectiveness can be expressed as a number of animals or as a percentage of the area's habitat capability. While habitat capability can not be increased, habitat suitability and effectiveness can be. Habitat suitability can be improved by managing habitats for seral stages that have higher productivity for grizzly bears (e.g. by conducting a prescribed burn to encourage the growth of berry producing shrubs). Habitat effectiveness can be improved by reducing human disturbance (e.g. by avoiding the use of a road through grizzly bear habitat during the period when bears might be expected to be present). Efforts to increase habitat effectiveness and suitability will produce the greatest benefits for grizzly bears when they are coordinated and focused on habitats with moderate to high habitat capability.

When considering the needs of grizzly bears within a GBPU it is important to recognize two distinct scales: stand and landscape. At the stand scale, grizzly bears require habitat secure from disturbance where the available food meets their needs. At the landscape scale these stand level habitats must be well distributed, encompass the full range of seasonal habitat needs and be accessible to grizzly bears (i.e. not subjected to impacts from displacement or fragmentation).

All of the following habitat strategies apply only to the "spine" area of the North Cascades GBPU which consists of the following sub-units: Manning East, Manning West, Similkameen, Coquihalla, Tulameen, Anderson, Coldwater, Ainslie, Spius and Siska (Figure 4). The only exception is if new information documents areas outside the "spine" where resident grizzly bear(s) are present. In that case these strategies would also be applied to those areas. The designation of the "spine" should be reviewed when the Recovery Plan is revised every five years based on any additional information obtained.

The reason for concentrating on the "spine" area is that it potentially encompasses sufficient habitat to achieve the Recovery Plan goal. The estimated minimum habitat capability of the "spine"sub-units is 199 grizzly bears (Appendix 5). More refinement of habitat assessments and experience with managing larger bear populations within the North Cascades will occur over time. Therefore, the geographic boundaries of the "spine" area should be reviewed at five year intervals (when the Recovery Plan is reviewed) and alterations made as necessary, based on any new information obtained.

The focus in areas outside the "spine" will be on other objectives such as minimizing grizzly bear/human conflicts and human-caused mortality. The current Core Areas (areas >500 m from an open road, see 4.1.4) of the sub-units in the "spine" have a total estimated minimum habitat capability of 119 grizzly bears or 79% of the Recovery Plan goal.

The habitat capability analysis conducted for the North Cascades GBPU indicates that in order to reach the recovery goal of 150 grizzly bears it would be necessary for the "spine" to support approximately 75% of the minimum estimated habitat capability for this area (i.e. 150 grizzly bears in an area whose minimum estimated habitat capability is 199 grizzly bears). This is a simplification as it is recognized that some grizzly bears will almost certainly spend some time and possibly extended periods outside the "spine".

The North Cascades GBPU habitat capability analysis also indicates that it is necessary to manage the habitat outside of Core Areas in order to achieve the Recovery Plan goal as the Core Areas within the "spine" alone would not be sufficient (i.e. the estimated minimum habitat capability of the Core Areas in the "spine" is 119 grizzly bears while the Recovery Plan goal is 150). This is particularly evident due to the fact that the existing Core Areas are biased toward higher elevations and therefore may not contain sufficient habitat during some seasons – notably the spring. In addition, many Core Areas in the "spine" are fragmented and are not of sufficient size alone to support a grizzly bear.

The following strategies seek to address the need to maintain, and, if necessary, restore, the habitat conditions required to support the Recovery Plan goal.

4.1.1 Habitat Suitability at the Stand Scale

Given the relative lack of salmon and large, wild ungulates (i.e. elk, moose or caribou) grizzly bears in the North Cascades are assumed to largely depend on plant forage to meet their nutritional needs. Non-forested and early seral habitat features typically provide quality foraging opportunities for grizzly bears by supporting high value plant species. These plant species can also be found at substantial densities in riparian forested habitats and under the canopy of, as well as within the small openings in, mature and old forests. Coarse woody debris associated with forests supports insects and small mammals that can also be valuable food sources for grizzly bears.

Forestry impacts on habitat suitability at the stand scale occur through the alteration of important habitats as a result of harvesting and/or silviculture. Livestock impacts on habitat suitability at the stand scale may occur through the alteration of important habitats as a result of grazing and trampling.

Strategies

a) Do not convert non-productive forest sites (e.g. willow, alder and other non-productive brush sites, avalanche chutes) into productive forest (i.e. through silvicultural intervention). *The intent of this strategy is to continue to allow productive forest areas that are harvested, burned by wildfire, destroyed by pests, etc. to be returned to productive forest.*

b) Encourage stewardship of high value grizzly bear habitat on non-Crown lands (e.g. through agreements with landowners).

c) Avoid livestock impacts to forage availability in important grizzly bear habitats (Table 2) through range use planning. Where necessary, implement measures such as salt placement, alternate water development, drift fencing, herding or altering periods of livestock use. *The intent of this strategy is that impacts on ranchers will be minimized. Specific instances and habitats impacted will be identified through field information and monitoring.*

d) Where practical, incorporate important grizzly bear habitats (Table 2) into Wildlife Tree Patches (WTPs) and Old Growth Management Areas (OGMAs) provided they meet the objectives for WTPs and OGMAs.

e) Consider grizzly bear foraging needs in the management of coarse woody debris (CWD) by retaining larger pieces within the limits of current provincial policy.

Table 2. Important Grizzly Bear Habitat Types and their Season of Use in the North Cascades Grizzly Bear Population Unit.[1]

Habitat Types	Season of Use		
	Spring *	Summer	Fall **
Riparian Management Areas, including wetlands (as described in the FPC Riparian Management Area Guidebook), as well as riparian habitats outside of Riparian Management Areas (Appendix 4: Table 5)	X	X	X
Avalanche tracks and run out zones	X	X	X
Hedysarum and glacier lily complexes	X	X	
Sub-alpine parkland meadows		X	X
Berry producing sites (Appendix 4: Table 6)		X	X

***Spring** refers to the period after bears emerge from their dens - late March through April until spring habitats are no longer used – usually the end of June.

****Fall** refers to the period when berries become abundant - often late July/early August through to November.

4.1.2 Habitat Effectiveness at the Stand Scale

Grizzly bears are easily disturbed by human activities. This disturbance can result in grizzly bears being unable to make use of otherwise suitable habitats. Roads result in direct habitat loss, however, even more importantly, they often have significant levels of human activity associated with them that can displace grizzly bears from nearby areas. By providing a 50 m buffer of cover between roads and important habitats, the impact on the habitat effectiveness of these sites is reduced. Despite such buffers, habitat effectiveness will still be impacted (albeit to a lesser degree) which is why at the landscape scale an emphasis is placed on the maintenance of areas >500 m from open roads where direct impacts on effectiveness are all but eliminated (see 4.1.4, strategy a).

In areas where human activity occurs, grizzly bears preferentially select foraging areas within approximately 200 m of effective hiding cover. By managing moderate to high capability habitats

[1] The habitats described are generalizations and are intended to be verified/identified where necessary through fieldwork and/or mapping by qualified personnel (see 4.1.5, strategy a, b and g).

to ensure that hiding cover is provided, grizzly bears can make more effective use of harvested cutblocks.

Grizzly bears can be displaced from important habitats by the presence of livestock as well as the human activity that accompanies livestock grazing. If grizzly bears are not displaced from these habitats, the result may be an increased risk of conflicts (see 4.4). Where livestock displacement of grizzly bears is a potential issue on Crown land this should be managed through range use planning.

Strategies

a) Plan to avoid constructing roads or recreational trails in, or within 50 m of, important grizzly bear habitats (Table 2) during layout and design. Where avoidance is not possible implement mitigation measures under 4.1.2, strategy b or c).
b) Where roads currently exist, or are constructed in the future, in important grizzly bear habitats (Table 2) plan to minimize potential displacement of grizzly bears by:
   - deactivating roads (ideally to 4X4 impassable) or restricting human access (e.g. gates, physical blockage, regulation or other means), and/or
   - constructing temporary roads or bridges in preference to permanent, and/or
   - minimizing right-of-way width, and/or
   - managing roadside vegetation to promote visual screening (e.g. by maintaining shrubs and understory vegetation as well as non-merchantable species, establishing WTPs as buffers (provided these buffers meet WTP objectives), partial removal harvesting of buffers and/or promoting the accelerated regeneration of harvested forest through planting of larger stock etc.) and/or
   - scheduling activities to avoid season(s) of use.
c) Where recreational trails currently exist, or are constructed in the future, in important grizzly bear habitats (Table 2) consider minimizing potential displacement of grizzly bears by:
   - re-routing trails, and/or
   - implementing temporary or permanent closures.
d) In moderate and high capability habitats[1] design cutblocks such that distance to cover (vegetation capable of hiding a bear) is less than 200 m by retaining shrubs, understory and/or WTPs within the block.
e) Establish security WHAs for grizzly bears under the FPC as described in the IWMS.
f) Avoid livestock displacement of grizzly bears from important habitats (Table 2) through range use planning (see 4.1.1, strategy c). *This strategy is included in the event that conflicts develop as bear numbers increase or new information is obtained. We are currently unaware of such conflicts. The intent of this strategy is to find solutions within the current framework for planning range use.*

4.1.3 Habitat Suitability at the Landscape Scale

At the landscape scale it is important to maintain a balance over time of spring, summer and fall habitats to support grizzly bears. Forestry can impact habitat suitability at the landscape scale if

[1] Defined by ecosystem mapping (see 4.1.5, strategy a) or, where this is not available, Broad Ecosystem Inventory.

extensive areas of mid-seral forest (i.e. closed canopy, high stocking density, conifer dominated) are created which tend to have little productive herb and shrub understory forage plants.

In the North Casacdes GBPU it has been suggested that spring habitats may be naturally limited which, if confirmed through forage supply analysis, would mean that maintaining spring habitat would be of particular importance (Gyug 1998).

In order to determine whether or not a particular habitat is limiting in an area it is necessary to conduct an analysis of forage supply. The results of a forage supply analysis can then be used to guide the application of specific strategies that seek to maintain and, where possible, increase the supply of the most critical habitats for the area in question.

Strategies

a) Develop grizzly bear guidelines for stocking standards in the Merritt and Lillooet Forest Districts.
b) Where forage supply is of concern for any season (see strategy 4.1.5, strategy a), maintain important habitats (Table 2) by:
   - establishing foraging WHAs for grizzly bears under the FPC as described in the IWMS, and,
   - managing riparian site series to lower target or minimum stocking levels.[1] *In the Chilliwack Forest District see Appendix 11 in the Vancouver Forest Region Establishment to Free Growing Guidebook and in the Penticton Forest District see the Okanagan-Shuswap Land and Resource Management Plan, Grizzly Bear Habitat Resource Management Zone. For the Merritt and Lillooet Forest Districts see strategy a.*
c) Where forage supply during the fall is of concern (see 4.1.5, strategy b), maintain areas for berry production within berry producing site series (Appendix 4: Table 6) by:
   - employing, unless not practicable, designated skid trails, over snow harvesting, and/or cable harvesting,
   - managing berry producing site series to lower target or minimum stocking levels,[1] *In the Chilliwack Forest District see Appendix 11 in the Vancouver Forest Region Establishment to Free Growing Guidebook and in the Penticton Forest District see the Okanagan-Shuswap Land and Resource Management Plan, Grizzly Bear Habitat Resource Management Zone. For the Merritt and Lillooet Forest Districts see 4.1.5, strategy a.*
   - avoiding adverse site preparation (e.g. broadcast soil disturbance; broadcast herbicide application),[2]
   - planning for voids (<1 ha) through mid-seral stages by cluster planting, juvenile spacing and thinning,[3]

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[1] For silvicultural purposes, reduced target stocking standards are intended to better reflect what natural stocking would be on these sites and facilitate greater productivity for bear food plants.

[2] Site preparation or other soil disturbance can negatively affect berry production particularly *Vaccinium* but also *Sambucus, Rubus* and *Sorbus sitchensis.*

[3] By managing for greater "openness" in reforested berry producing stands these stands will produce berries for a longer period of time than would occur with application of normal reforestation techniques.

- increasing habitat suitability on sites with moderate to high capability habitat through timber harvesting, prescribed burns or reduced action to control wildfires, juvenile spacing, thinning or other techniques.

4.1.4 Habitat Effectiveness at the Landscape Scale

Habitat effectiveness for grizzly bears is significantly impacted by human disturbance associated with roads. At the landscape scale areas >500 m from roads (referred to as "Core Areas") receive greater use by grizzly bears than areas in close proximity to roads. Very limited use (as well as increased mortality risk) tends to occur in areas where open road density (ORD) is high (i.e. >0.6 km/km^2).

There is no known minimum threshold for the proportion of a landscape in Core Area above which recovery would be certain or below which it would be impossible. Based on the available information, all else being equal, (notably habitat quality, seasonal distribution of habitats and the size and degree of fragmentation of Core Areas), landscapes with higher proportions of Core Area and lower proportions of high ORD area are more likely to support the recovery and maintenance of grizzly bear populations. Until more information is available for the grizzly bears in the North Cascades the intent of the strategies under this objective is to minimize both the loss of Core Area and the increase in high ORD area based on 1999 levels (Table 3, Table 4).

For comparison purposes in the U.S. portion of the North Cascades (the North Cascades Recovery Zone), federal lands are managed for no net loss of Core Area. In the Cabinet-Yaak and Selkirk Mountain Recovery Zones the minimum baseline for Core Area is 55% of the land area and in the Northern Continental Divide Recovery Zone the minimum baseline is 68% (R. Naney pers. comm.).

These targets were based on the amount of Core Area within the home ranges of radio collared female grizzly bears within each recovery zone (IGBC 1998). Differences in the level of Core Area within female grizzly bear home ranges among the recovery zones may be related to habitat quality, land management designation, bear density, or other factors and baselines may change as determined by research or management needs.

Strategies

a) Plan access to minimize, and where possible avoid, the net loss of Core Area from 1999 levels (Table 3, Figure 5) by sub-unit and begin planning to stabilize Core Area at 1999 levels as soon as possible.[1] *Ideally new Core Areas would be established prior to accessing existing Core Area, would be of equal or greater habitat value and would remain as a Core Area for a minimum of 10 years. Where possible the preference is to maintain or recover large, contiguous blocks of Core Area (i.e. >1 000 ha).*

[1] While recognizing the need for some flexibility to allow for completion of existing approvals and commitments as well as unforeseen events (e.g. wildfire, insect outbreaks).

Table 3. Percentages of Core Area in each "Spine" Sub-unit.

Sub-unit	Core Area (km^2)	Total Sub-unit Area (km^2)	% Core Area
Ainslie	199.3	389.1	51.3
Anderson	218.4	522.1	41.9
Coldwater	175.4	316.3	55.5
Coquihalla	444.0	680.6	65.2
Manning East	384.1	432.3	88.8
Manning West	750.0	892.1	84.1
Similkameen	401.7	904.0	44.5
Siska	207.8	357.6	58.1
Spius	360.4	691.9	52.1
Tulameen	574.0	1 063.2	54.0
Total	**3 715.0**	**6 249.1**	**59.4**

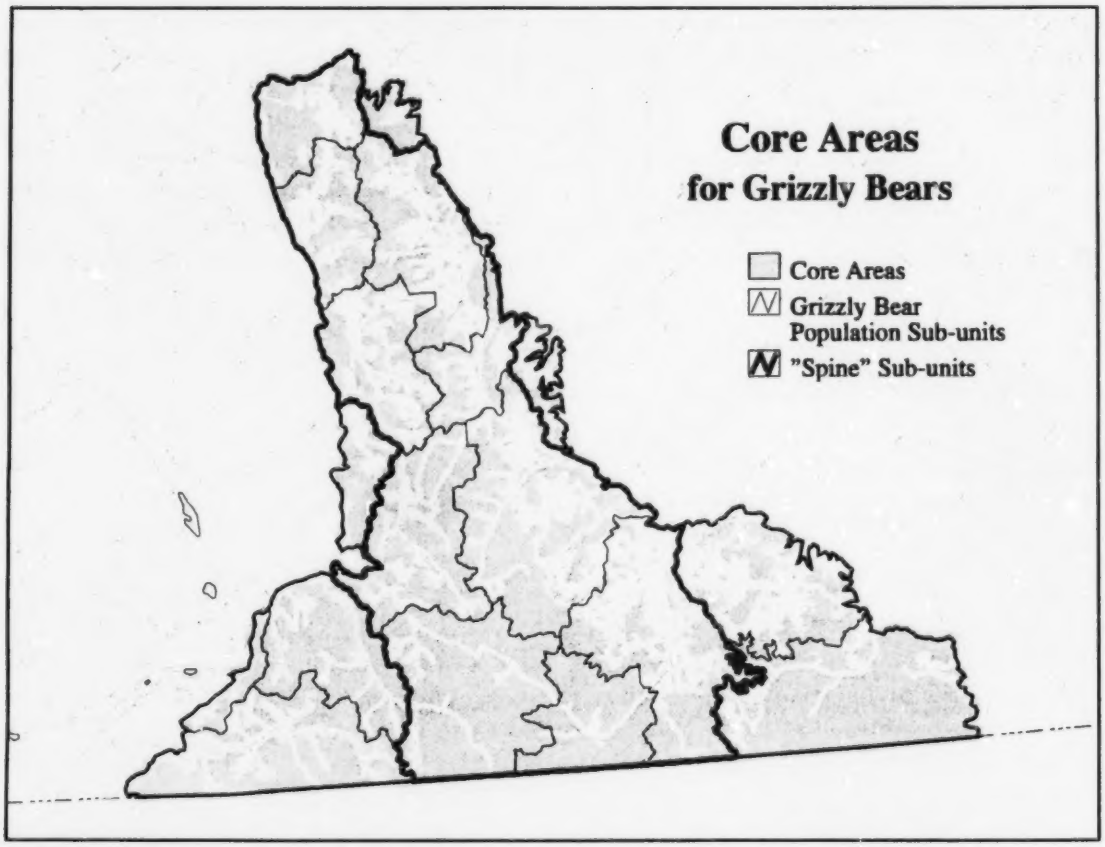

Figure 5. Core Areas in the North Cascades Grizzly Bear Population Unit.

b) Plan access to minimize, and where possible avoid, the net increase from current 1999 levels in the proportion of high ORD area by sub-unit (Table 4, Figure 6) and begin planning to stabilize the proportion of area with high ORD at 1999 levels as soon possible.[1]

c) Complete access management plans for the sub-units in the "spine" area.

d) Apply access management measures such as signage, road deactivation, gating or physical blockages and/or legal restrictions as necessary and appropriate to implement strategies a-c. *The intent of this strategy is that access control measures such as gating and legal restrictions will only be implemented following adequate public consultation.*

e) In areas where access management plans have not yet been completed (see strategy c), identify and, where possible based on consultation with stakeholders, eliminate or deactivate non-status roads (with a priority on creating Core Area).

f) In areas where access management plans have not yet been completed (see strategy c), avoid establishing a history of public use on newly constructed roads or road segments within Core Areas wherever practical. *The intent of this strategy is that non-recreational uses of these roads (e.g. mining and livestock grazing) would be allowed.*

Table 4. Percentages of each "Spine" Sub-unit in Areas with High Open Road Density (ORD).*

Sub-unit	High ORD Area (km^2)	% High ORD Area	Total Sub-unit Area (km^2)
Ainslie	178.6	45.9	389.1
Anderson	293.9	56.3	522.1
Coldwater	127.8	40.4	316.3
Coquihalla	278.4	40.9	680.6
Manning East	96.8	22.4	432.3
Manning West	190.9	21.4	892.1
Similkameen	533.4	59.0	904.0
Siska	139.8	39.1	357.6
Spius	332.8	48.1	691.9
Tulameen	515.7	48.5	1 063.2
Total	2 688.1	43.0	6 249.1

* Open Road Density (ORD) based on a Moving Windows Analysis with 30-m pixel size and a 0.98 km^2 window.

[1] While recognizing the need for some flexibility to allow for completion of existing approvals and commitments as well as unforeseen events (e.g. wildfire, insect outbreaks).

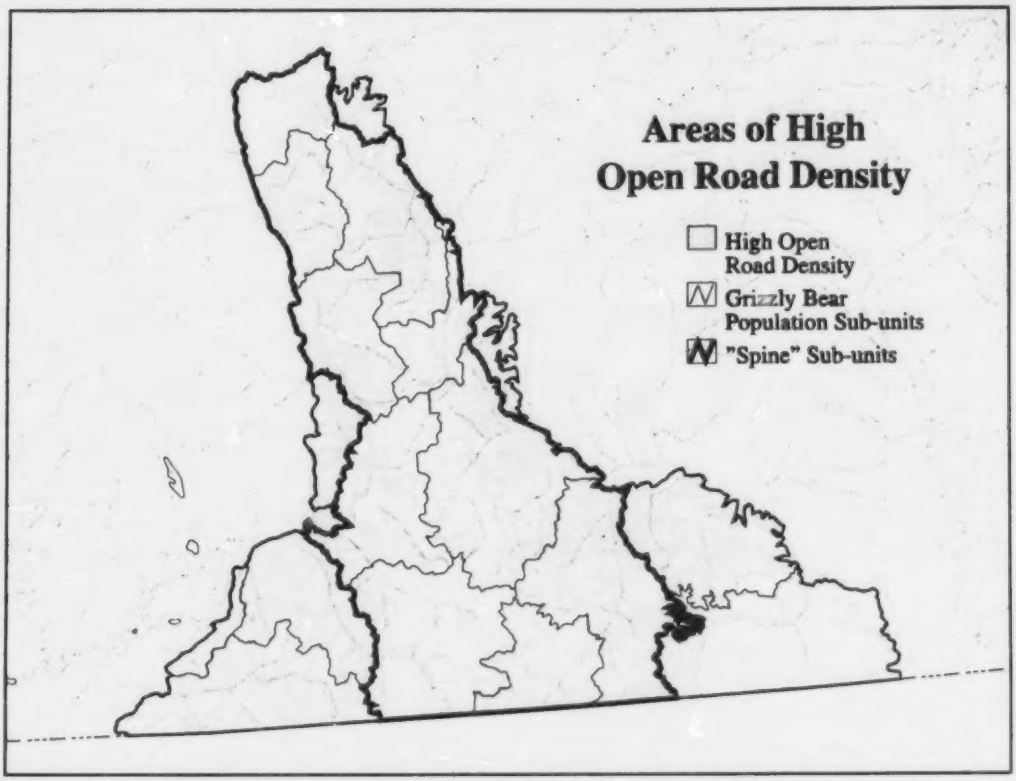

Figure 6. Areas Where Open Road Density Exceeds 0.6km/km^2.

g) Avoid connecting road networks over the height of land between watersheds. *The intent of this strategy is to facilitate access management and not to eliminate options for drainages where such an approach is the only practicable means of obtaining access.*
h) Consider using aerial harvesting, a two pass system, relaxing green-up requirements and/or allowing larger cutblocks (i.e. >40 ha) where necessary to achieve access targets.
i) In appropriate areas, consult with stakeholders on establishing regulations to limit the recreational use of motorized vehicles in Core Areas from April 1 to October 31.
j) Where possible, minimize human disturbance (e.g. repeatedly landing helicopters) in Core Areas from April 1 to October 31.
k) Do not dispose of Crown land where there is likely to be an adverse impact on grizzly bears or grizzly bear habitat that can not be mitigated.

4.1.5 Information Needs

In order to make the best possible decisions regarding the management of grizzly bear habitat it is critical to understand its seasonal and spatial distribution. It is also important to determine how current levels of human use are distributed within grizzly habitat. The following strategies seek to improve our understanding of grizzly bear habitat in the North Cascades GBPU as well as human impacts on the ability of grizzly bears to use this habitat.

Strategies

a) Complete ecosystem mapping for the North Cascades GBPU at a preferred scale of 1:20 000 (minimum scale of 1:50 000) and assign seasonal habitat capability and suitability ratings.[1]
b) Verify the accuracy of habitat mapping and the productivity of these habitats for grizzly bears.
d) Model short and long-term forage supply to identify sub-units of concern based on ecosystem mapping.
c) Assess levels of human use (e.g. traffic volume and seasonal timing, use of recreational trails) within the North Cascades GBPU.
d) Develop a model of habitat effectiveness and assess whether or not additional measures to maintain or improve habitat effectiveness are necessary in order to achieve the recovery goal over the long-term.
e) Undertake research on grizzly bear habitat use, movements and response to human activity in the North Cascades.
f) Establish permanent vegetation plots throughout the North Cascades GBPU (with an emphasis on berry-producing areas) to monitor annual variation in forage production.
g) Develop guidelines for identifying important grizzly bear habitats in the field (see Table 2).

4.2 Objective 2: Prevent population fragmentation and maintain genetic diversity

The viability of small populations is increased if linkages can be maintained to other populations. Small, isolated populations are much more vulnerable to random or catastrophic events and may suffer reduced survival and/or reproduction through the effects of inbreeding and the loss of genetic diversity.

The following strategies seek to maintain, and where possible restore, linkages for grizzly bears between the North Cascades and Stein-Nahatlatch GBPUs, to maintain and restore linkages within the North Cascades GBPU and to increase the genetic diversity of the North Cascades grizzly bear population.

4.2.1 Linkage With Other Grizzly Bear Populations and Within the GBPU

The North Cascades grizzly bear population is isolated from the nearest population – the Stein-Nahatlatch GBPU – by the major transportation corridor and associated human developments and activity along the Fraser Canyon. Within the North Cascades GBPU the Coquihalla toll freeway (which has been fenced for much of its length) and, to a lesser extent, the Hope-Princeton Highway, likely represent at least partial barriers to grizzly bear movements.

Strategies

a) Identify and assess the viability of potential linkages across the Coquihalla toll freeway, the Hope-Princeton Highway and the Fraser Canyon.
b) Assess current human activities within potential linkages and consider measures available to mitigate conflicts with grizzly bears.
c) Consult with relevant agencies, local governments, First Nations and stakeholders on the designation of potential linkages as Grizzly Bear Management Areas (GBMAs) under the *Wildlife Act*.

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[1] Ecosystem mapping to be completed according to approved Resource Inventory Committee standards.

d) Avoid disposing of Crown land within linkage GBMAs.
e) Incorporate measures to accommodate grizzly bear use of linkage GBMAs within any treaties encompassing these areas.
f) Pursue partnerships with non-governmental organizations to promote stewardship of private lands within linkage GBMAs.
g) Consult with the Ministry of Transportation and Highways, the Ministry of Forests, BC Parks and local governments on measures to increase the ability and/or willingness of grizzly bears to cross segments of highway within linkage GBMAs and to reduce the risk of mortality on roads (i.e. signage, crossing structures, lower speed limits, no stopping areas, provision of cover adjacent to the highway, carcass removal, bear-proof garbage cans etc.).
h) Make linkage GBMAs a high priority for the application of strategies under objective 4&5 (conflict and mortality).

4.2.2 Genetic Diversity

Due to the small size of the population, and the fact that it appears to have been isolated from other grizzly bear populations for many decades, it is all but certain that the genetic diversity of grizzly bears in the North Cascades has declined dramatically from historic levels. This loss of genetic diversity may already be resulting in reproductive and survival impacts due to inbreeding and is one of several possible explanations for the failure of the population to recover in the absence of active recovery efforts over the last few decades. The loss of genetic diversity also has the potential to impact the capacity of a population to respond to changes in the environment.

Strategies

a) Augment the population genetically through translocation of grizzly bears from other GBPUs (as per objective 3).
b) Establish a repository for grizzly bear genetic material from the North Cascades GBPU and surrounding areas as well as a database for genetic analyses completed to facilitate monitoring and research.

4.3 Objective 3. Increase the number of grizzly bears to achieve the population goal

The current estimated number of grizzly bears in the North Cascades is very small and will likely not survive over the long-term without the addition of animals from other areas. When populations are small and spread over large areas, the risk of the population being lost due to either a slow decline or one or more catastrophic or random events increases dramatically.

There are no viable grizzly bear populations contiguous to the North Cascades, and therefore no bears likely to contribute toward recovery by natural dispersal. Augmentation is the only alternative available for increasing the number of grizzly bears in the North Cascades over the short-term. This technique has previously been used successfully in Austria, Italy and in the Cabinet/Yaak Ecosystem in the United States to supplement small populations of brown bears.

Strategies

a) Augment the population by translocating up to five wild caught grizzly bears per year for five years into the North Cascades GBPU. Grizzly bears translocated as part of the population augmentation will:

- be marked and fitted with a radio-telemetry device prior to their release to allow their movements to be tracked,
- ideally be taken from the nearest viable grizzly bear population(s) in the Coast Range (the focus will be on bears on the lee of the Coast Range that are thought to make minimal use of salmon), and,
- will include females in preference to males and subadults in preference to adults.

Public notification for any grizzly bears moved into the North Cascades GBPU will be provided through news releases or other communications means.

b) Augmentation will only occur in the Manning West and Manning East sub-units. These sub-units were chosen according to the following criteria:
   - sub-units with a high proportion of Core Area,
   - sub-units with a high proportion of protected area,
   - sub-units with high proportions of high to moderate suitability habitat available through several seasons based on the best available mapping or expert opinion, and
   - sub-units with a low likelihood of grizzly bear/human conflicts based on current human use and settlement patterns and current or planned access levels.

c) Augmentation will not occur until the recovery team is satisfied that the necessary work to reduce the likelihood of bear/human conflicts in the Manning East and Manning West sub-units has been completed, including a hazard assessment for Cascades Recreation Area, E.C. Manning Provincial Park and Skagit Provincial Park.

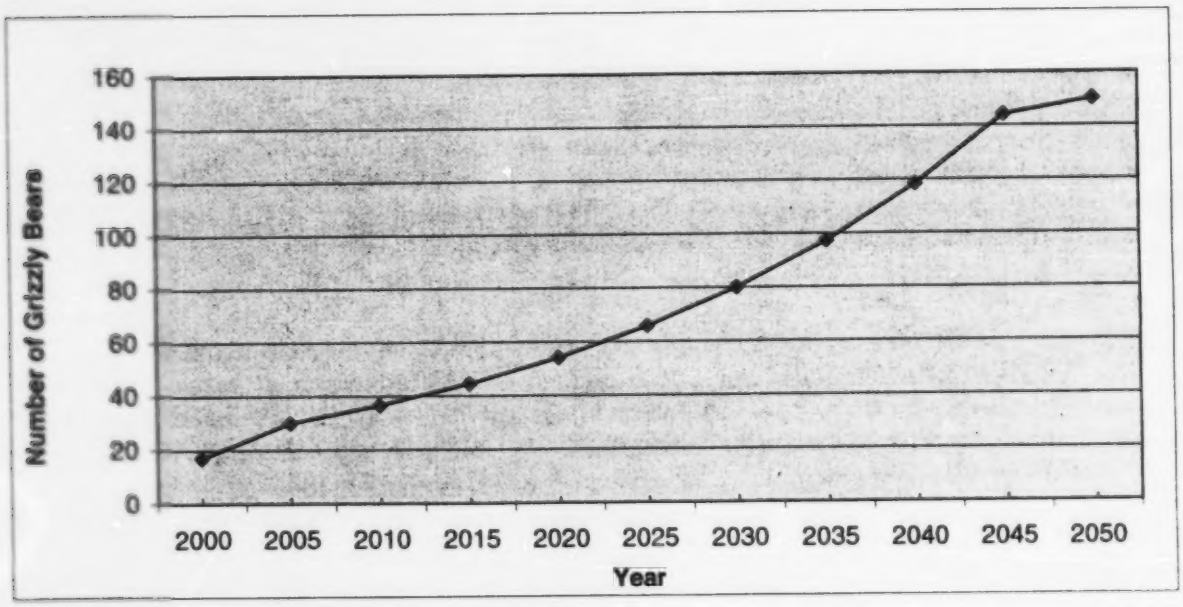

Figure 7. Estimated Growth of the North Cascades Grizzly Bear Population.

4.4 Objective 4. Minimize the potential for grizzly bear/human conflict

Grizzly bears occupy approximately 85% of British Columbia and represent a very minor risk to human safety. Each year on average approximately 2.5 people are injured by grizzly bears and 0.3 are killed (or one person every three years) in the province. Even when the recovery goal is achieved (150 grizzly bears) the density of grizzly bears in the North Cascades will be relatively low – approximately 1.5 grizzly bears/100 km^2.

In an average year in British Columbia there are approximately 300 complaints arising from actual or potential conflicts with grizzly bears. Given that there are estimated to be a minimum of 13 000 grizzly bears in the province, this represents an average of ≤2.5 complaints/100 grizzly bears annually. In fact, the actual level or rate of grizzly bear/human conflicts in any given area is much more closely linked to human behaviour than to the size or density of its grizzly bear population.

With responsible management of attractants such as garbage, education of people working or recreating in grizzly bear habitat and proactive management of individual grizzly bears that are at risk of becoming involved in conflicts, it is possible to substantially reduce the level of conflicts that occur. Measures that seek to reduce conflicts with grizzly bears would also be expected to reduce conflicts with black bears which are much more numerous and are involved in approximately 30 times more complaints on average each year in British Columbia.

Regardless of the relatively low risk to human safety represented by grizzly bears it is critical to minimize this risk to the greatest degree possible while allowing for the conservation of this sensitive species. It is also important to minimize any damage to private property that might be caused by grizzly bears despite the fact that this risk is also expected to be relatively small. Minimizing grizzly bear/human conflicts is a significant conservation issue as well. Although human injury is quite rare, conflicts between grizzly bears and humans commonly result in the grizzly bears involved being destroyed which is particularly problematic for small populations such as the North Cascades (see 4.5.). The following strategies seek to reduce the potential for such conflicts and outline the response to those that do occur.

Strategies

a) Develop and implement a public information and education program to minimize grizzly bear/human conflicts.
b) Consider potential grizzly bear/human conflicts and options for mitigation prior to authorizing new land-use activities such as commercial recreation, range use, forestry activity, mining exploration and mineral extraction. *The intent of this strategy is not to unduly impede the process for authorizing these land use activities. Issues to be considered include the management of attractants and training of staff.*
c) Conduct bear hazard assessments on existing trails and campgrounds and consider modifications where hazards are moderate or high.
d) Reduce the availability of non-natural attractants such as garbage to grizzly bears by bear-proofing garbage cans, dumpsters and landfills.
e) Require bear-proofing of remote industrial or research camps.

f) Promote discussions with private landowners, ranchers and highway maintenance crews regarding disposal of carcasses in grizzly bear habitat. If necessary, implement carcass redistribution program in the spring to distract grizzly bears from potential conflict areas. *Carcass redistribution has been used successfully in other jurisdictions (e.g. Montana and Alberta) to reduce conflicts between grizzly bears and livestock.*
g) Do not allow sheep grazing on Crown land within the North Cascades GBPU. *Experience in other areas has demonstrated that conflicts between grizzly bears and sheep are best avoided by not permitting sheep grazing on public lands where grizzly bears are likely to be present.*
h) Establish a grizzly bear response team led by the Conservation Officer Service to respond to and manage grizzly bear/human conflicts.
i) Develop criteria for responding to grizzly bear/human conflicts (i.e. when aversive conditioning will be used, when animals will be translocated and when animals will be destroyed).
j) Where practical, use aversive conditioning to respond to potential grizzly bear/human conflicts.
k) Where translocation is necessary the preference is to relocate animals within the North Cascades GBPU or, if this is not practical, to another threatened population.
l) Where practical, instrument grizzly bears involved in, or at risk of becoming involved in, conflicts with humans so that their movements can be monitored and so that management actions can be taken where necessary (see strategy h-k).
m) Encourage non-governmental groups to establish a program to compensate livestock producers for any losses due to grizzly bear depredation that might occur.

4.5 Objective 5. Minimize human-caused mortality of grizzly bears

Given the small numbers of grizzly bears remaining in the North Cascades, preventing avoidable deaths (especially of adult females) is critical to population recovery. The greatest risk of human-caused mortality in the North Cascades is likely related to potential grizzly bear/human conflicts (see 4.4) although road and train kills, poaching, deaths resulting from capturing and handling animals and mistaken identity kills by black bear hunters are also potential sources of mortality. The following strategies seek to reduce the likelihood of human-caused mortality of grizzly bears in the North Cascades GBPU.

Strategies

a) Develop and implement an information and education program to minimize grizzly bear mortality (see 4.4, strategy a).
b) Develop and implement a program to reduce the likelihood of mistaken identity kills by black bear hunters (e.g. by preparing a brochure on bear species identification).
c) Ensure that only personnel experienced in the capture, immobilization and handling of grizzly bears have direct contact with animals during any research, translocation or augmentation efforts.
d) Develop, implement and coordinate a proactive enforcement program to deter poaching.
e) Work with the Ministry of Transportation and Highways, BC Parks, industry and others to reduce the risk of grizzly bears injury or death from vehicle collisions (see 4.2.1, strategy g).

4.6 Objective 6. Increase scientific and public knowledge of, and support for, grizzly bear recovery in the North Cascades

Recovery of the North Cascades grizzly bear population will require public, institutional and stakeholder support. The scientific knowledge of North Cascades grizzly bears is quite incomplete, largely because the population is currently so small and dispersed and therefore difficult to study. The following strategies seek to increase the scientific knowledge of grizzly bears in the North Cascades in order to guide recovery efforts and to increase the public's understanding and support for recovery efforts.

Strategies

a) Develop and implement a grizzly bear information and education program (see 4.4, strategy a) that includes local businesses, schools, community organizations and the general public.
b) Develop a Communications Strategy to guide efforts to keep First Nations and stakeholders informed of, and involved in, recovery efforts.
c) Develop a Questions & Answers brochure on grizzly bear recovery in the North Cascades GBPU.
d) Improve the current system for reporting and tracking grizzly bear sightings to encourage greater participation by staff, stakeholders and the public.
e) Encourage research on grizzly bears and grizzly bear habitat in the North Cascades.
f) Undertake fundraising to support the implementation of the Recovery Plan.
g) Publicize the results of monitoring and research efforts annually.

4.7 Objective 7. Facilitate interagency cooperation and management of the North Cascades grizzly bear population

Since the North Cascades is a cross-border population it is vital that efforts to recover this population in British Columbia be closely coordinated with the work being undertaken in the State of Washington. It is equally important that the various agencies responsible for the management of grizzly bears and their habitats in British Columbia continue to work together to achieve recovery. The following strategies are intended to ensure that this interagency cooperation is maintained and enhanced.

Strategies

a) Produce an annual newsletter for staff and managers in the relevant agencies on the status of recovery efforts in the North Cascades.
b) Brief the FPC Joint Steering Committee semi-annually on the status of recovery efforts in the North Cascades.
c) Maintain members on the NCGBRT from the North Cascades Subcommittee of the IGBC and the FPC Ministries.
d) Maintain membership from British Columbia on the North Cascades Ecosystem Subcommittee of the IGBC.

5 MONITORING

It is critical that monitoring be conducted on an on-going basis to assess the success of the various strategies in the Recovery Plan in contributing toward progress on achieving the plan's goal. This monitoring should include an indicator(s) of population size and distribution, habitat

conditions (including human impacts), grizzly bear mortalities and the number and nature of any conflicts.

5.1 Population Size and Distribution

In assessing the success of recovery efforts in the North Cascades GBPU from a conservation perspective the most important issue is the actual status of the grizzly bear population itself. Direct monitoring of the total number of grizzly bears in the North Cascades GBPU is not feasible. Therefore, observations of female grizzlies with cubs of the year will be used as an indicator of total population size. In addition, the total number of reliable grizzly bear sightings (all sexes and age classes) will be tracked.

Indicators

a) The running three year average number of confirmed, unduplicated sightings of female grizzly bears with cubs of the year observed (see Appendix 3). ***The Recovery Plan goal will be considered to have been achieved when this indicator exceeds an average of nine confirmed, unduplicated sightings of female grizzly bears with cubs of the year observed.***
b) The total number and distribution of reliable grizzly bear sightings received annually.

5.2 Habitat Conditions

Maintaining effective habitat for grizzly bears is fundamental to achieving recovery. The most significant factor concerning habitat effectiveness is the level of impact associated with roads. The productivity of grizzly bear foods – particularly berry production – varies substantially from year to year and can assist in explaining changes in grizzly distribution or activity.

Indicators

a) The proportion of each sub-unit in the "spine" area that is within Core Areas.
b) The habitat capability, seasonal habitat value, spatial distribution and sizes of Core Areas within each sub-unit in the "spine" area.
c) The proportion of each sub-unit in the "spine" area that is within high ORD areas.
d) The phenology and productivity of grizzly bear food plants at permanent vegetation plots (see 4.1.5, strategy f).

5.3 Grizzly Bear Mortalities

It is critical to track any human-caused mortality of grizzly bears from the North Cascades as limiting these losses will be vital to achieving recovery. Natural mortalities of grizzly bears that are documented will also be tracked to assist in assessing population status.

Indicators

a) The number, age, sex, cause and location of grizzly bear mortalities in and within 10 km of the North Cascades GBPU (except any mortalities within another GBPU).

5.4 Grizzly Bear/Human Conflicts

Monitoring the incidence of grizzly bear/human conflicts will be important in providing managers with the information needed to identify problem areas and to take steps to prevent future conflicts.

Indicators

a) The number, nature and location of grizzly bear/human conflicts in and within 10 km of the North Cascades GBPU (except any mortalities within another GBPU).

6 GLOSSARY

Bear Hazard Assessment – a technical review of the potential risk of bear/human conflict including both natural bear habitat use and the management of non-natural attractants

Coarse Woody Debris – dead or dying wood on the forest floor in all stages of decay (including above-ground logs, exposed roots and large fallen branches), that is >10 cm diameter

Core Area – an area >10 ha in size and >500 m from any open road

Extirpated – a species that no longer exists in the wild in a particular area but that continues to exist in the wild elsewhere

Grizzly Bear Population Unit – a defined area encompassing an individual grizzly bear population whose boundaries are based on barriers to grizzly bear movement and/or ecological differences

Habitat Capability – the ability of habitat, under optimal conditions to provide the life requisites of a species, irrespective of its current conditions

Habitat Effectiveness – the actual ability of habitat to provide the life requisites of a species given the suitability of the habitat and the human disturbance and fragmentation of the area

Habitat Suitability – the ability of habitat, under its current conditions to provide the life requisites of a species, irrespective of human impacts aside from those that directly alter the habitat itself

Landscape Unit – an area of land and water delineated by topographic or geographic features that is used for long-term planning of resource management activities under the *Forest Practices Code of British Columbia Act*

Non-natural Attractants – any artificial food source that may attract bears to an area such as garbage, human foodstuffs, animal feed and dead livestock

Non-productive Forest Sites – habitats that are incapable of growing a merchantable stand of commercial forest within a reasonable length of time without silvicultural intervention

Old Growth Management Areas – an area established under the *Forest Practices Code of British Columbia Act* that contains, or is managed to replace, structural old growth attributes

Open Road – a road without restriction on motorized vehicle use

Open Road Density – the linear distance of open roads per square kilometer

Road – all created or evolved routes that are reasonably and prudently driveable with a conventional passenger car or pickup

Restricted Road – a road on which motorized vehicle use is restricted seasonally and/or that has an effective physical obstruction (generally gated)

Riparian Habitat – the area adjacent to a watercourse, lake, river, stream or wetland that includes both area dominated by continuous high soil moisture content and the adjacent upland vegetation that exerts an influence on it

Wildlife Habitat Area – a mapped area of land that the Deputy Minister of Environment, Lands and Parks, or their designate, and the Chief Forester, have determined is necessary to meet the habitat requirements of one or more species of identified wildlife

Wildlife Tree – a standing live or dead tree with special characteristics that provides valuable habitat for wildlife

Wildlife Tree Patch – an area specifically identified for the retention and recruitment of suitable wildlife trees

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8 APPENDICES

8.1 Appendix 1. Grizzly Bear Biology

8.1.1 Taxonomy and Evolution

The North American brown bears (*Ursus arctos*) include two subspecies: the grizzly bear (*Ursus arctos horribilis*) and the Kodiak bear (*Ursus arctos middendorfii*) (Rausch 1963). Recent taxonomic classifications consider the North American brown bears and the Eurasian brown bear to be the same species.

The evolutionary history of the family *Ursidae* encompasses a 20 million year period. The Etruscan bear (*Ursus etruscus*) which lived in the forests of Asia about 2 million years ago was ancestor to present day bears (Herrero 1972). Changes in environment from warm forest to a treeless landscape following repeated glacial periods gave rise to the cave bear (*Ursus spelaeus*) in Europe and the brown bear in Asia. Around 50 000 years ago brown bears crossed the treeless Bering Land Bridge and spread across North America (Churcher and Morgan 1976).

A major trend in the early evolution of bears was the development of an adaptation that allowed a carnivore to feed relatively efficiently on vegetation (Kurten 1968). Bears began as small-bodied carnivores but eventually became large-bodied omnivores (Herrero 1985). The brown bear specifically evolved away from forest adaptations toward characteristics that allowed this species to utilize a more open habitat. Brown bears developed morphological, physiological, and behavioral adaptations that enabled them to exploit the newly developed tundra-like habitat following glacial periods. Today brown bears depend on a variety of habitats for their seasonal needs.

8.1.2 Physical Characteristics

Grizzly bears exhibit considerable variation in size and color of local populations and individuals sometimes leading to problems in classification between grizzly and black bears. Guard hairs are often silver-tipped to varying degree hence the name "grizzly." The muscle structure has developed for strength, quickness, and speed. Grizzly bears are often distinguished from black bears by their humped shoulders, longer and curved claws, smaller ears, and a concave face profile.

Male grizzly bears are considerably larger than females (Glenn 1980). In addition to variations between sexes, there is considerable variation in body size and weight between geographic regions. Weight data from various studies are available in IGBC (1987). There appears to be a clinal variation in weight with bears in coastal regions being heavier than bears in the more interior regions of the continent (Bunnell and Tait 1981). Rausch (1963) noted that the larger size of coastal bears appeared to be related with distribution of salmon and luxuriant coastal vegetation.

Grizzly bears undergo an annual cycle in weight, gaining in summer and losing during winter denning (Pearson 1975, Kingsley et al. 1983). Grizzly bears can gain weight at the rate of up to 1 kg/day during the spring to fall season (Blanchard 1983, Bunnell and Hamilton 1983). Male

bears lose 8-22% of their fall weight over winter while females lose 18-40% (Blanchard 1987, Kingsley et al. 1983).

8.1.3 Reproduction

There is clear evidence that the female grizzly bear exhibits delayed implantation (Craighead and Mitchell 1982). Although mating occurs during spring (generally May and June), and estrous may last 30 days, blastocysts do not implant in the uterine wall until autumn. Implantation is affected by the physical condition of the female. Grizzly bears are polygamous; a female may mate with several males during a single breeding period. Female grizzly bears are not sexually mature until age four or five and exhibit prolonged care of their young. Generally, females attend to their litter for two years. Litter size may vary from 1-4 cubs although two cubs is most common. Grizzly bears may live to be 40 years old (Storer and Tevis 1955).

8.1.4 Movements

Grizzly bears are a wide-ranging species and mobility is an important aspect of grizzly bear biology (IGBC 1987). As such grizzly bear populations require large tracts of suitable habitat wherein individuals can move freely and establish home ranges.

The home range size of grizzly bears depends on many factors such as the juxtaposition of seasonal habitats, population density, age and reproductive status, and social relationship with other members of the population (IGBC 1987). Home range size may also vary among years in relation to food abundance and may enlarge as the animal ages (Blanchard and Knight 1991). Generally males have larger home ranges than females. It is advantageous for male ranges to include as many female ranges as possible, and it is advantageous for females to rear young in relatively small areas with maximum security and food resources. Sub-adult males generally disperse from the maternal home range whereas females often establish home ranges near their mother (IGBC 1987, Craighead and Mitchell 1982). In coastal areas female home ranges may be smaller than 25km^2 while in low productivity areas in the interior male home ranges can exceed 2 500km^2 (IGBC 1987).

8.1.5 Habitat Selection and Food Habits

The grizzly bear is an omnivore, and as such displays great flexibility in its use of habitats and foods. Grizzly bears are opportunistic feeders and will scavenge or prey on most available prey species. Where prey is less abundant, vegetal matter, roots, and bulbs are important during spring (IGBC 1987). After leaving their dens during spring, bears may utilize relatively low elevation habitats although individual variation occurs. During spring, grizzly bears often forage in riparian areas, avalanche chutes, or low elevation ungulate winter ranges. As summer progresses, bears often move to higher elevations and shift to fruit. In the fall, where salmon resources are available bears will congregate to feed on these migrating fish. Where salmon are not available bears continue to feed on vegetal matter until denning.

Grizzly bears hibernate during winter months generally in high-elevation excavated dens (above and below tree line). Bears generally enter their dens from late September to early November and remain in dens until early March to early May. During the denning period, body temperature is

only slightly reduced while heart rate and respiration are more markedly depressed. Several weeks of lethargy occur prior to and subsequent to denning (Nelson et al. 1983).

8.1.6 Human Impacts

There is very little overlap between occupied grizzly bear habitat and high human densities (Mattson 1990). Unoccupied but suitable habitat occurs in many parts of North America where human use has not been compatible with the survival of bears. Large-scale habitat conversion to human settlement, hydroelectric development, and agriculture have reduced bear use of many inter-mountain valleys. Timber harvest and fire control policies have also contributed to large-scale conversion of habitat by altering the mosaic of habitats and forest successional stages required by bears.

Forest roads and other transportation corridors (e.g. highways, utility corridors, railways) affect grizzly bears in several ways (McLellan and Shackleton 1988, Mace et al. 1996). Displacement effects can extend up to 500 m or more from roads. Grizzly bears are also vulnerable to mortality in areas with roads. Measures such as temporary roads, narrow right-of-way width and seasonal use restrictions can reduce the impacts associated with roads.

Impacts on grizzly bears in areas where livestock (particularly sheep but occasionally cattle also) are grazed include direct mortality through control actions to protect property and illegal kills, habitat loss or modification, displacement, or direct competition (IGBC 1987). Historically, conflict with livestock was a major cause of population decline or local extirpation throughout the grizzly bear's former range (Storer and Tevis 1955). Depredation behavior is believed to be a learned process as not all bears in proximity to grazing allotments kill livestock. Current research and management strategies to address conflicts between livestock and bears shows promise (M. Madel pers. comm.).

8.2 Appendix 2. Description of land use activities in the North Cascades GBPU

8.2.1 Forestry

Many of the smaller communities surrounding the North Cascades GBPU are dependent on forest and range resources as their primary source of income. The Ministry of Forests administers both the forest and range resources located within the provincial forests, and is responsible for timber harvesting, silviculture, range, recreation, and fire protection activities. The North Cascades GBPU includes portions of the following Forest Districts: Chilliwack, Merritt, Penticton and Lillooet (see Figure 8).

Logging has occurred within the North Cascades GBPU for over 100 years, however, it has only been in the last 40 to 50 years that significant areas have been harvested for timber. Changes to timber harvesting technology and markets in the last 30 years have seen an increase in mid to high elevation harvesting. Road construction has preceded harvesting in most if not all cases, leaving an extensive road network available for other users.

In all four districts, a significant proportion of the timber harvested comes from mature and old stands. Over time, as these stands are harvested and replaced, the annual volume harvested may decline down to a lower, steady, long term level. It is anticipated, however, that actual area of timber harvested annually will remain relatively constant through time.

In the Merritt TSA, due to a current beetle infestation and a 10 000 ha wildfire in 1998, the current allowable annual cut has been temporarily increased by 40% to provide for salvaging of affected timber.

8.2.2 Mining

The North Cascade GBPU covers an important mining region of B.C. Geologically it straddles the juncture of the Coast Mountain and Intermontane belts, represented by a complex assemblage of predominantly northwest-trending belts of volcanic, sedimentary, intrusive and metamorphic rocks. The complex geological evolution has produced many kinds of metallic and industrial mineral deposits that have sustained exploration activity and mining for nearly 150 years.

The principal commodities found in the North Cascades GBPU include copper, gold, silver, lead, zinc, nickel, molybdenum, coal, placer gold, limestone, jade, stone (decorative and structural), sand and gravel, silica, and others. The Coquihalla gold belt, parallel to the Hozameen fault, and the Nicola belt, extending from Princeton north beyond the Highland Valley, are the two most important mineral belts from the standpoint of known discoveries, past mine production, and future potential. Diligent prospecting continues to result in new discoveries annually and in newly discovered extensions of known deposits. For some commodities, such as coal, improved market economics and technology may re-establish interest in known deposits.

In late 1999, subsurface tenures covered 79 790 ha (8.14%) of the North Cascades GBPU. Mineral tenures covered 76 733 ha (7.83%); placer tenures covered 5 457 ha (0.56%); and coal tenures covered 2 801 ha (0.29%). There are currently no petroleum and natural gas, or geothermal tenures. Natural gas pipelines traverse the area bringing northeastern gas to mainland

markets. *Land Act* tenures for sand and gravel extraction were not documented but are believed to cover <1% of the North Cascades GBPU.

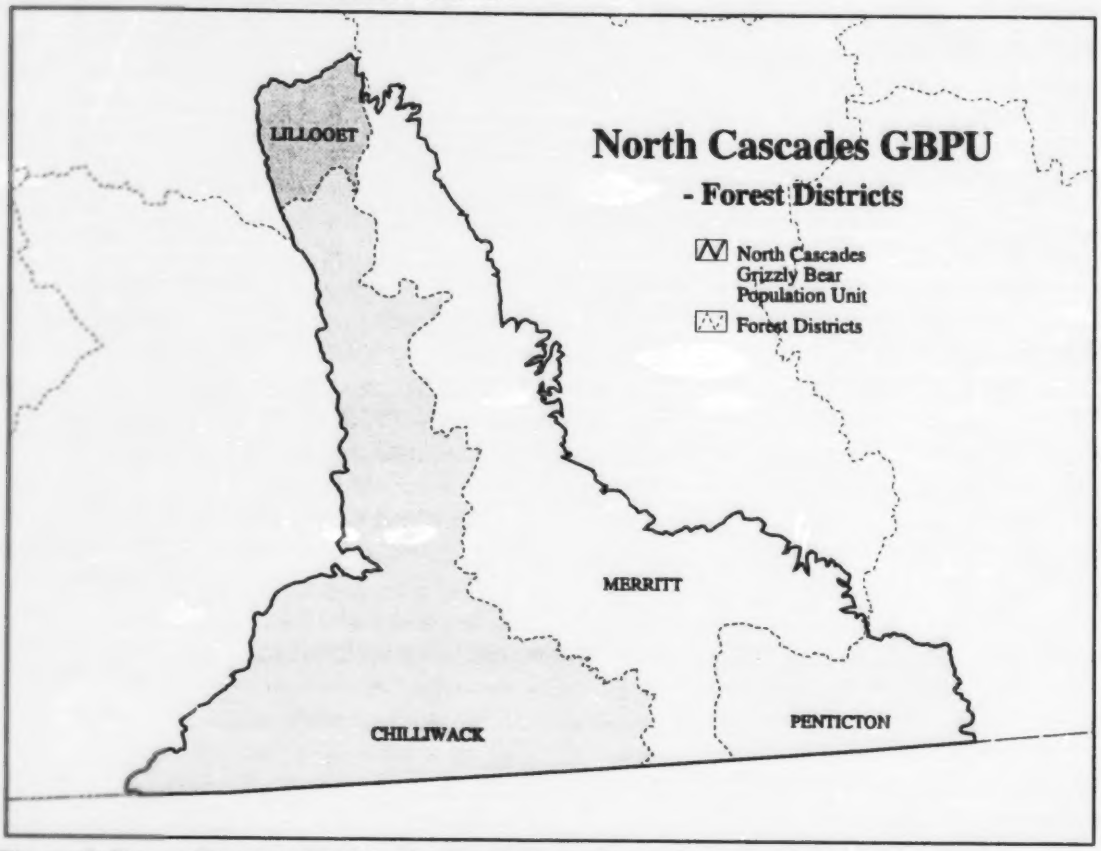

Figure 8. Forest Districts Within the North Cascades Grizzly Bear Population Unit.

The Ministry of Energy and Mines maintains a mineral occurrence database (MINFILE) for the province that documents all known mineral occurrences and classifies them according to their significance. Data for the North Cascades GBPU show 394 mineral occurrences that include: 3 producers; 12 developed prospects; 59 past producing mines; 98 prospects; and 222 showings. Further analysis of the MINFILE database indicates that 8 of the 18 (44%) Grizzly Bear Population Sub-units in the North Cascades contain deposits with established mineral reserves.

8.2.3 Agriculture

Ranching and agriculture are prevalent in the eastern portions of the North Cascades GBPU including approximately 20 ranches in operation (i.e. in the Merritt and Penticton Forest Districts), however there are no ranches or other agriculture activities in the Chilliwack Forest District portion of the GBPU. A small portion of the grazing land in the North Cascades GBPU is privately held, however, most of the grazing is on Crown land under a variety of tenures.

Crown land tenures are primarily held for livestock cow/calf or yearling spring, summer, and/or fall grazing. Calving in grizzly spring range, and sheep grazing conflicts with grizzly are not

currently known to be a problem in the North Cascades. Ranchers have reported bear predation or injury to cattle, but typically these events have been traced to black bears. Gyug (1998) notes one recorded kill of a grizzly bear in defense of cattle in the late 1970s. Crown range cattle grazing tenures including alpine areas and cattle damage to riparian areas may be in conflict with grizzly bear management objectives in a few areas.

Other significant agriculture activities adjacent to or within grizzly habitat include vegetable, and fruit growing operations, ginseng farms and hay operations. Again, all these activities take place in the eastern part of the recovery area.

8.2.4 Residential

Several residential communities exist within or immediately adjacent to the boundaries of the North Cascades GBPU. In the eastern portion of the GBPU, there are only three major population centres located close to the boundaries including Merritt (1996 pop. 7 631), Princeton (1996 pop. 2 826) and Keremeos (1996 pop. 1 167 with approximately 4 500 in the surrounding area). As well, in the east there are a number of small rural communities including: Tulameen, Coalmont, and Eastgate. These communities consist of well under 300 people located in close proximity to valuable, occupied grizzly habitat. There are no documented grizzly conflicts associated with people or property in Merritt, Princeton or Keremeos.

There are also a few small residential communities in or near the western portion of the North Cascades GBPU. The largest community located immediately on the western boundary is Hope (1996 pop. 6 312). The population of Hope is predicted to increase to over 9 000 people by 2008. Boston Bar (1996 pop. 329 including rural areas to south) is located in the Fraser Canyon on the western boundary of the GBPU with a further 1 500 or more First Nation's persons living on Indian Reserves in the area. Population growth in this region over the next 10 years is expected to be minimal. Other small communities include Sunshine Valley (1996 pop. 112), Othello (1996 pop. 42), and Chilliwack Lake and area (1996 estimate, 200). Small population increases are expected in these settlement areas. Lytton (1996 pop. 322) is located on the north west boundary of the GBPU at the confluence of the Fraser and Thompson rivers.

8.2.5. Transportation and Utility Corridors

There are currently three major transportation routes through the North Cascades GBPU: the Fraser Canyon, occupied by the Trans-Canada Highway (Highway #1) and the Canadian Pacific and Canadian National railways; the Coquihalla toll freeway (Highway #5); and the Hope-Princeton Highway (Highway #3) (Figure 3).

The Fraser River forms the western boundary of the North Cascades GBPU and is a natural corridor through this mountainous area. The Cariboo Wagon Road was opened through the Fraser Canyon in the mid 1860s providing the first access through the area on anything other than foot trails. The Canadian Pacific Railway was completed through the area in 1886. The Fraser Canyon is currently the site of the Trans-Canada Highway as well as two major railway lines.

The first formally established trail through the North Cascades was the Hudson Bay Brigade Trail from Tulameen to Hope located just north of what is now E.C. Manning Provincial Park. It was

used from 1849 to 1860, after which it fell into disuse because of the opening of the Dewdney Trail further south in 1860. The first permanent road through the Cascade Mountains was completed in 1949 when the Hope-Princeton Highway was opened through Allison Pass and E.C. Manning Provincial Park.

The Kettle Valley Railway was built through the North Cascades in the 1910s along the Coquihalla and Coldwater Rivers but was abandoned in 1959. This same route currently holds the major oil and natural gas pipelines that supply the lower mainland of B.C. The Coquihalla Highway, a multilane express toll highway, was completed through this route in 1986. Most of its route through the Coldwater valley has also been fenced on both sides with 2.4 m height page-wire fencing to prevent deer from wandering onto the highway (this fencing further restricts bear movement or dispersal opportunities).

There is also an extensive network of secondary roads built primarily for timber extraction in the North Cascades. Outside of the E.C. Manning and Cathedral Provincial Park areas, there is no point in the North Cascades GBPU that is more than 7 km from a road or clearcut (Gyug 1998).

8.2.6 Recreation and Protected Areas

The human population within the North Cascades GBPU is very small, however, it is adjacent to the most densely populated portions of B.C. with approximately 68% of British Columbia's population of 3 724 500 (1996 census) within a day trip's reach of the area. The North Cascades GBPU is about halfway between the dense population centre of the Lower Mainland where about 2 000 000 people reside and the next most populous area on mainland B.C. in the Okanagan Valley where about 450 000 people reside.

The opening of the Coquihalla Highway in 1986 has meant that all areas of the North Cascades are now within an easy single day's outing from the two major population centres on the mainland of B.C. Road systems developed for timber harvesting are also extensively used by recreationists. This easy access and low level of settlement means that the North Cascades provides many opportunities for wilderness-type experiences and activities. The demands for recreation in the form of camping, hiking, mountain biking, horseback riding, riding snow machines and all terrain vehicles, fishing, hunting, river rafting, hang gliding, mountain climbing and wildlife viewing among other pursuits have increased substantially over the last 10 years. This trend is expected to continue for the next 20 years as the populations of the Lower Mainland and Okanagan continue to increase.

Recreational opportunities in the North Cascades GBPU are numerous, with the main providers being BC Parks, the Ministry of Forests and private individuals. The Parks Division of the Ministry of Environment, Lands and Parks is responsible for the administration of the provincial parks, recreation areas and ecological reserves. The Ministry of Forests administers recreation sites and trails within the provincial forests. The various Forest Districts provide maintained camping facilities and a complex of trails throughout the GBPU. A number of the trail systems have historical interest and are maintained by various societies and associations on more of an ad hoc basis. The Trans Canada Trail initiative plans to upgrade some of the existing trail systems and build new trails over the next several years. Dispersed-use camping (unauthorized) outside of

the Forest Service designated campsites is common throughout the year, and occurs where access is provided.

Within the North Cascades GBPU 16.9% of the area is within provincial parks or other protected areas. The largest of these protected areas include E.C. Manning (665.6 km^2), Cathedral (328.9 km^2), Skagit (279.7 km^2), Chilliwack Lake (92.7 km^2) and International Ridge (18.7 km^2) Provincial Parks; Cascade (176.3 km^2) and Coquihalla (57.9 km^2) Recreation Areas; and Liumchen Creek Ecological Reserve (21.8 km^2). These eight areas account for 99.1% of the protected areas in the North Cascades GBPU. The smaller provincial parks include Skihist, Coldwater River, Alexandra Bridge, Nicolum River, and part of Cultus Lake. The smaller recreation areas include Coquihalla River and Coquihalla Canyon while smaller Ecological Reserves include Skihist, Stoyoma Creek, Whipsaw Creek, Skagit River Cottonwoods, Skagit River Forest, Skagit River Rhododendrons, Ross Lake and Chilliwack River.

Within the North Cascades GBPU, there are 10 vehicle-access campgrounds with a total of 727 campsites within provincial parks. About half of these campsites are within E.C. Manning Provincial Park.

The Chilliwack Forest District provides recreational opportunities to the public through nine recreation sites in the Chilliwack River Valley and one at Silver Lake in the Silver/Skagit River drainage. Public recreation within the North Cascades GBPU in the Merritt Forest District is provided through access to 19 recreation sites and 12 recreation trails (including the Hudson Bay Brigade Heritage Trail and the Centennial Trail). The Penticton Forest District has two recreation sites and one recreation trail within the GBPU. The Lillooet Forest District does not maintain any recreation facilities within the GBPU, however, rock-hounding, hiking, and a vehicle "circle tour" are popular activities in the area.

The North Cascades GBPU is covered by portions of readily available and up-to-date hiking or recreation guidebooks. These describe both hiking trail and logging road access opportunities within the area.

There are a number of commercial recreation providers that use the area for hang gliding, guided tours, river rafting and mountaineering. Horseback guide/outfitter trips also occur within some portions of the GBPU. To date most of these operations have not been registered with the BC Assets and Lands Corporation.

8.2.7 Hunting

Grizzly bear hunting has not been permitted within the North Cascades GBPU since 1974. There are spring and fall hunting seasons for black bears throughout the area. Regulations for other big game species vary within the management units that overlap the GBPU, but there are general open hunting seasons only for mule or black-tailed deer bucks in the fall, and for coyote and cougar through the winter. There are additional hunting seasons for white-tailed deer, antlerless mule deer, moose, elk and wolves in parts of the area, some of which are managed by lottery-type award of limited entry hunting permits. There are limited entry hunts for bighorn sheep in a small

portion of the North Cascades. There are also various small game and trapping seasons in most of the North Cascades.

As of 1996 there were only three guide-outfitters in the North Cascades licensed to conduct the hunts that are required by regulation for out-of-province hunters. Most of the hunters in the area are B.C. resident hunters. During the fall hunting seasons, virtually all accessible roads are used by hunters. The only large areas of public land closed to hunting are E.C. Manning Provincial Park and the core area of Cathedral Provincial Park. The other large provincial parks and recreation areas are open to hunting within legal seasons. Ecological Reserves and the smaller provincial parks are closed to hunting as are areas within 400 m of Highway #3 (the Hope-Princeton) through the North Cascades. Areas within 400 m of Highway #5 (the Coquihalla freeway) are closed to use of single-projectile firearms. The Chilliwack River road from Thurston Correctional Institute east to Chilliwack Lake is closed to the discharge of firearms for 800 m either side of the road. Hunting is allowed in the headwaters of the Tulameen River and in upper Vuich Creek area but only by non-motorized access.

8.2.8 First Nations

There are 20 First Nations bands with interests in the North Cascades GBPU. The Shx'wow'hamel, Peters, Popkum, Cheam, Yakweakwioose, Tzeachten and Soowahlie bands are members of the Sto:lo Nation. The Cook's Ferry, Coldwater, Lower Nicola, Nooaitch, Shackan and Siska bands are members of the Nicola Tribal Association. The Upper Similkameen and Lower Similkameen bands are members of the Okanagan Nation Alliance and the Nicomen band is affiliated with the Fraser Canyon Indian Administration. The Boothroyd, Boston Bar and Spuzzum bands are members of the Nlaka'pamux Nation Tribal Council and the Yale band is independent.

8.3 Appendix 3. Description of the Method Used to Estimate Grizzly Bear Population Size in the North Cascades GBPU

Since it is not possible to directly count or monitor the total number of grizzly bears in the North Cascades GBPU an "indicator" was selected to aid in determining when the population goal has been achieved. The indicator is a running three year average of confirmed observations of female grizzly bears with cubs of the year. The population goal will be considered to have been achieved when this indicator exceeds nine confirmed female grizzly bears with cubs of the year. This target was developed using the following assumptions which are adopted from the Grizzly Bear Recovery Plan for the United States (U.S. Fish and Wildlife Service, 1993):

- The running three year average is based on the reproductive cycle of female grizzly bears (each adult female would normally be with cubs of the year for one out of every three years and therefore one third of adult females will be with cubs of the year on average in any given year).
- The running average of females with cubs of the year can be multiplied by three to estimate the minimum number of adult females in the population.
- It is estimated that only 60% of females with cubs of the year will be detected and confirmed in any given year (Aune and Kasworm, 1989).
- It is assumed that the proportion of subadults to adults in the North Cascades grizzly bear population is 1:1 (IGBC, 1987).
- It is assumed that the proportion of females to males in the North Cascades grizzly bear population is 1:1 (IGBC, 1987).
- Based on the assumptions above the proportion of adult females in the population is estimated to be 28.4% (using the method of Knight et al., 1988).

A target of sighting at least eight females with cubs should correspond to a population of approximately 150 grizzly bears using the method of Knight et al. (1988) as follows:

- 9 females with cubs of the year seen divided by 0.6 (sightability correction factor) = 15 total females with cubs of the year;
- 15 x 3 = 45 adult females;

45 divided by 0.284 (the estimated proportion of adult females in the population) = a minimum of 158 grizzly bears.

It should be noted that a number of these assumptions may be inaccurate for grizzly bears in the North Cascades (e.g. 60% sightability of females with cubs of the year) and should be refined through research over the course of the Recovery Plan's implementation. However, at this time it remains the best information available.

8.4 Appendix 4. Riparian and Berry Producing Habitats in the North Cascades GBPU.

Table 5. Riparian Habitats in the North Cascades Grizzly Bear Population Unit.

Biogeoclimatic Subzone Variants	Site Series
CWHdm	07, 12, 14, 15
CWHds1	07, 12
CWHms1	06, 11
CWHvm2	07, 08, 11
CWHxm1	07, 12, 14, 15
ESSFdc2	06, 07, 08
ESSFmw	06, 07, 08
ESSFxc	07, 08
IDFdk1	05, 06
IDFdk2	05, 06, 07
IDFww	06, 07
IDFxh1	08
IDFxh1a	98, subhydric
IDFxh2	07, 08, subhydric
MHmm2	06, 07, 09
MSdm2	06, 07
MSxk	08, 09, subhydric
PPxh2	07, subhydric

Table 6. High and Moderate Berry (principally *Vaccinium*) Producing Site Series in the North Cascades Grizzly Bear Population Unit.[1]

Biogeoclimatic Subzone Variants	High Berry Productivity Site Series	Moderate Berry Productivity Site Series
CWHdm	12	
CWHms1	02, 01, 05, 06, 11	03
CWHvm2	03, 01, 05, 06, 07, 09, 10, 11	02, 04
ESSFdc2	05	01, 06, 07
ESSFmw	04, 01, 05, 06, 07	02, 08
ESSFxc		06
MHmm2	02, 01, 04, 05, 06, 07, 08	03, 09

[1] Principal sources are Lloyd *et al.* (1990) and Green and Klinka (1994).

8.5 Appendix 5. Total and Core Area Habitat Capability by Sub-unit in the North Cascades GBPU

Table 7. Total and Core Area Habitat Capability by Sub-unit in the North Cascades Grizzly Bear Population Unit.[1]

Sub-unit	Capability Class[2]	Total Area (sq km)	Core Area (sq km)	Total Capability	Core Capability
Ainslie	2	199	99	10.2	5.1
Ainslie	3	0	0	0.0	0.0
Ainslie	4	132	45	0.8	0.3
Ainslie	5	56	54	0.1	0.1
Ainslie	6	2	0	0.0	0.0
		389	**199**	**11.0**	**5.4**
Anderson	2	339	108	17.3	5.5
Anderson	3	74	39	1.9	1.0
Anderson	4	69	35	0.4	0.2
Anderson	5	38	36	0.0	0.0
Anderson	6	2	0	0.0	0.0
		522	**218**	**19.7**	**6.8**
Ashnola	2	4	2	0.2	0.1
Ashnola	3	613	526	15.9	13.7
Ashnola	4	142	134	0.8	0.8
Ashnola	5	231	144	0.2	0.1
Ashnola	6	1	1	0.0	0.0
		991	**808**	**17.2**	**14.7**
Chilliwack	2	379	143	19.3	7.3
Chilliwack	3	229	183	6.0	4.7
Chilliwack	5	113	112	0.1	0.1
Chilliwack	6	19	10	0.0	0.0
		741	**448**	**25.4**	**12.2**
Coldwater	2	162	82	8.3	4.2
Coldwater	3	76	42	2.0	1.1
Coldwater	4	4	2	0.0	0.0
Coldwater	5	73	50	0.1	0.1
		316	**175**	**10.3**	**5.3**

[1] "spine" sub-units in italics
[2] see Table 8

Table 7 (cont.)

Sub-unit	Capability Class	Total Area (sq km)	Core Area (sq km)	Total Capability	Core Capability
Coquihalla	2	378	180	19.3	9.2
Coquihalla	3	179	142	4.7	3.7
Coquihalla	4	34	34	0.2	0.2
Coquihalla	5	88	87	0.1	0.1
Coquihalla	6	1	1	0.0	0.0
		681	**444**	**24.2**	**13.2**
Fraser Valley South	2	80	32	4.1	1.6
Fraser Valley South	3	22	18	0.6	0.5
Fraser Valley South	5	2	2	0.0	0.0
Fraser Valley South	6	3	0	0.0	0.0
		107	**51**	**4.7**	**2.1**
Lower Nicola River	2	34	29	1.8	1.5
Lower Nicola River	3	59	35	1.5	0.9
Lower Nicola River	4	1	1	0.0	0.0
Lower Nicola River	5	9	9	0.0	0.0
		104	**73**	**3.3**	**2.4**
Manning East	2	287	259	14.6	13.2
Manning East	3	56	53	1.5	1.4
Manning East	4	62	60	0.4	0.4
Manning East	5	27	11	0.0	0.0
Manning East	6	1	1	0.0	0.0
		432	**384**	**16.5**	**14.9**
Manning West	2	420	330	21.4	16.8
Manning West	3	193	168	5.0	4.4
Manning West	4	133	110	0.8	0.7
Manning West	5	143	139	0.1	0.1
Manning West	6	3	2	0.0	0.0
		892	**750**	**27.4**	**22.0**
Otter	2	43	15	2.2	0.8
Otter	3	93	29	2.4	0.7
Otter	4	3	1	0.0	0.0
		139	**45**	**4.6**	**1.5**

Table 7 (cont.)

Sub-unit	Capability Class	Total Area (sq km)	Core Area (sq km)	Total Capability	Core Capability
Silverhope	2	307	163	15.7	8.3
Silverhope	3	164	147	4.2	3.8
Silverhope	5	90	89	0.1	0.1
Silverhope	6	7	3	0.0	0.0
		567	**403**	**20.0**	**12.2**
Similkameen	2	258	192	13.2	9.8
Similkameen	3	344	148	8.9	3.8
Similkameen	4	24	21	0.1	0.1
Similkameen	5	277	41	0.3	0.0
Similkameen	6	1	0	0.0	0.0
		904	**402**	**22.5**	**13.7**
Siska	2	114	68	5.8	3.5
Siska	3	18	15	0.5	0.4
Siska	4	19	16	0.1	0.1
Siska	5	204	109	0.2	0.1
Siska	6	2	0	0.0	0.0
		358	**208**	**6.6**	**4.1**
Smith-Willis	3	469	217	12.2	5.6
Smith-Willis	4	0	0	0.0	0.0
Smith-Willis	5	226	75	0.2	0.1
Smith-Willis	6	1	1	0.0	0.0
		696	**293**	**12.4**	**5.7**
Spius	2	313	196	16.0	10.0
Spius	3	177	71	4.6	1.8
Spius	4	21	21	0.1	0.1
Spius	5	179	73	0.2	0.1
Spius	6	2	1	0.0	0.0
		692	**360**	**20.9**	**12.0**
Tulameen	2	682	367	34.8	18.7
Tulameen	3	159	79	4.1	2.0
Tulameen	4	119	98	0.7	0.6
Tulameen	5	103	31	0.1	0.0
		1 063	**574**	**39.7**	**21.3**

Table 7 (cont.)

Sub-unit	Capability Class	Total Area (sq km)	Core Area (sq km)	Total Capability	Core Capability
Yale	2	164	86	*8.3*	*4.4*
Yale	3	36	31	0.9	0.8
Yale	5	11	11	0.0	0.0
Yale	6	3	0	0.0	0.0
		214	**128**	**9.3**	**5.2**
GBPU Total		**9 807**	**5 173**	**293**	**160**
"Spine" Total (*Sub-units in italics*)		**6 249**	**3 715**	**199**	**119**

Table 8. Habitat Capability Classes and Densities.

Habitat Capability Class	Estimated Minimum Grizzly Bear Density (grizzly bears/100 km^2)
1 (Very High)	76
2 (High)	51
3 (Medium)	26
4 (Low)	6
5 (Very Low)	1
6 (Nil)	0

8.6 Appendix 6. Work Plans

This appendix outlines the actions necessary to implement the Recovery Plan over the next five years (after which the plan is intended to be revised). Activities are prioritized as: 1 (high), 2 (moderate) or 3 (low).

Table 9. Work Plan for 2001/2002.

Activity	Priority	Responsibility	Budget
Complete a CAMP for the Tulameen sub-unit.	1	MELP, MOF & MEM (district)	$20 000 15 days
Implement and maintain access management signage and control structures (and/or road deactivation) where agreed to through stakeholder consultation.	1	MELP, MOF & MEM (district)	$25 000 10 days
Compile existing biophysical mapping for the North Cascades GBPU, identify priority areas to be mapped and seek funding for additional mapping.	1	MELP (headquarters, region and parks)	5 days
Conduct bear hazard assessments on existing trails and campgrounds within protected areas in the Manning West and Manning East sub-units.	1	MELP (headquarters and parks)	$20 000 10 days
Begin reducing the availability of non-natural attractants such as garbage to grizzly bears by bear-proofing campsites, garbage cans, dumpsters and landfills.	1	MELP (headquarters, region and district) & MOF (district)	$20 000 5 days
Develop and implement a public information and education program to minimize grizzly bear/human conflicts, minimize grizzly bear mortality, encourage stewardship or grizzly bear habitat and encourage reporting of sightings.	1	MELP (headquarters, region, district and parks)	$15 000 10 days
Undertake monitoring of population size and distribution, habitat conditions, grizzly bear mortalities and grizzly bear/human conflicts.	1	MELP, MOF & MEM	$40 000 5 days
Provide input on grizzly bear recovery to referrals.	1	MELP (district)	10 days
Initiate fundraising to support the implementation of the Recovery Plan.	1	MELP (headquarters)	5 days

Table 9 (cont.)

Activity	Priority	Responsibility	Budget
Coordinate with non-governmental organizations on the development and implementation of a livestock compensation program.	1	MELP (headquarters and district) & MOF (district)	5 days
Begin augmenting the population through translocation of grizzly bears from other GBPUs.	1	MELP (headquarters and region)	$35 000 15 days
Begin research on grizzly bear habitat use and movements.	1	MELP (headquarters, district and parks)	$20 000 10 days
Develop an outreach program to encourage stewardship of grizzly bear habitat on private lands.	2	MELP (district)	$5 000 2 days
Model long-term forage supply to identify sub-units of concern for areas with available mapping.	2	MELP (headquarters) & MOF (region)	10 days
Assess levels of human use.	2	MELP (headquarters, district and parks) & MOF (district)	3 days
Identify and assess the viability of potential linkages.	2	MELP (headquarters and district)	$15 000 5 days
Develop guidelines for avoiding livestock impacts to grizzly bear habitat suitability and effectiveness.	3	MELP & MOF (district)	2 days
Identify and propose WHAs for grizzly bears.	3	MELP (district)	$5 000 5 days
Establish a repository and database for grizzly bear genetic material.	3	MELP (headquarters)	5 days
Produce and circulate first annual newsletter.	3	MELP (headquarters)	3 days
Total			**$220 000 137 days**

Table 10. Work Plan for 2002/2003 – 2005/2006.

Activity	Priority	Responsibility	Budget (Annual)
Complete a CAMP for the Anderson, Spius, Ainslie and Similkameen sub-units (in order, 1/year).	1	MELP, MOF & MEM (district)	$20 000 15 days
Implement and maintain access management signage and control structures (and/or road deactivation) where agreed to through stakeholder consultation.	1	MELP, MOF & MEM (district)	$25 000 10 days
Develop a model for assessing habitat effectiveness.	1	MELP (headquarters)	10 days
Coordinate additional biophysical mapping.	1	MELP (headquarters and region)	5 days
Conduct bear hazard assessments on existing trails and campgrounds in the Tulameen, Anderson, Spius, Ainslie sub-units (in order, 1/year).	1	MELP (headquarters and district) & MOF (district)	$10 000 2 days
Reduce the availability of non-natural attractants.	1	MELP (headquarters, region and district) & MOF (district)	$20 000 5 days
Implement public information and education program.	1	MELP (headquarters, region, district and parks)	$15 000 10 days
Continue augmenting the population through translocation of grizzly bears from other GBPUs.	1	MELP (headquarters and region)	$35 000 15 days
Continue research on grizzly bear habitat use and movements.	1	MELP (headquarters and district)	$20 000 10 days
Undertake monitoring of population size and distribution, habitat conditions, grizzly bear mortalities and grizzly bear/human conflicts.	1	MELP, MOF & MEM	$40 000 5 days

Table 10 (cont.)

Activity	Priority	Responsibility	Budget (Annual)
Provide input on grizzly bear recovery to referrals.	1	MELP (district)	10 days
Continue fundraising to support the implementation of the Recovery Plan.	1	MELP (headquarters)	5 days
Coordinate with non-governmental organizations on the implementation of a livestock compensation program.	1	MELP (district) & MOF (district)	2 days
Implement outreach program to encourage stewardship of high value grizzly bear habitat on private lands.	2	MELP (district)	$5 000 2 days
Continue research on grizzly bear habitat productivity.	2	MELP (headquarters)	$10 000 5 days
Identify and propose WHAs for grizzly bears.	3	MELP (district)	$5 000 2 days
Produce and circulate second annual newsletter.	3	MELP (headquarters)	1 day
Brief the FPC Joint Steering Committee semi-annually on the status of recovery efforts.	3	MELP (headquarters)	1 day
Total			**$205 000** **115 days**

8.7 Appendix 7. Potential Funding Sources for Implementation of the Recovery Plan

Implementation of this Recovery Plan will require support from a wide variety of sources. The following list is a summary of potential sources of funding for the activities described under the plan.

Provincial Government
- Ministry of Environment, Lands and Parks
- Ministry of Forests
- Ministry of Energy and Mines

Federal Government
- Canadian Wildlife Service

North Cascades Grizzly Bear Ecosystem Subcommittee (U.S.)

Skagit Environmental Endowment Commission

Habitat Conservation Trust Fund

Grizzly Bear Trust Fund (including fundraising specifically directed towards this Recovery Plan)

Forest Renewal BC

Environmental Non-Governmental Organizations